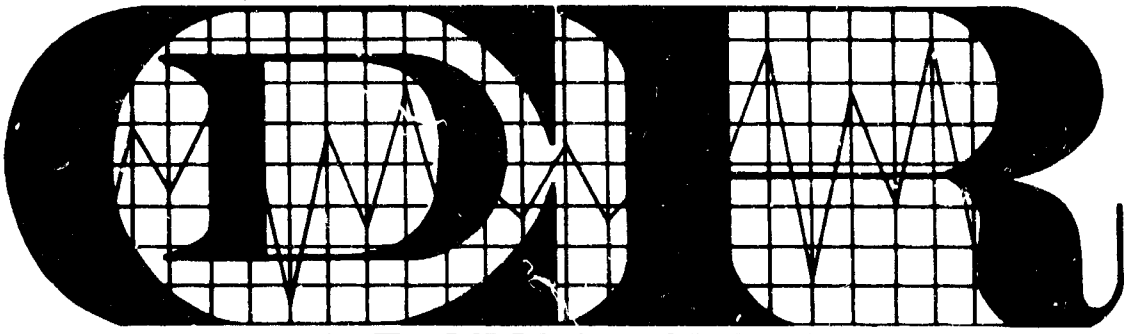
CIVIL DEFENSE RESEARCH



UNIVERSITY OF GEORGIA
PSYCHOLOGICAL LABORATORIES

Civil Defense Research
Psychological Laboratories
University of Georgia
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APPENDICES

SHELTER OCCUPANCY STUDIES
at the University of Georgia

1962-1963

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Introduction

The Final Report on the University of Georgia Shelter Occupancy Studies synthesized the test series as a whole. The appendices contained herein give the story of each study in detail and were written upon respective completion of each particular test group. An instrumentation appendix has also been included.

In event of discrepancy between Final Report information and Appendices information, the former should be regarded as having precedent.

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Electronics Design and Development Group

- Shelter construction
- Design and development
  - sensing devices
  - recording devices
  - environmental control devices
- Equipment installation
- Equipment maintenance
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- Recruitment
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- Group members:
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- Medical evaluation
  - pre-shelter testing
  - post-shelter testing
- Physical fitness evaluation
  - pre-shelter testing
  - post-shelter testing
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- In-shelter activity program
- In-shelter behavioral evaluation
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  - Mr. Watson
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Outline of Appendices

Appendix B

Pilot Studies I, II, and III

SECTION I

Pilot Study I

Pilot Study I

A. Purpose

The primary purpose of Pilot Study I was to check instrumentation, observation forms, and questionnaires. Experimental variables involved are listed in Table I.

B. Shelterees

Publicity for Pilot Study I was primarily by word of mouth. Through personal friends, neighbors, church and Sunday school affiliates and people attached to other departments of the University, the need for applicants was publicized over the Athens area. The county agents of the University of Georgia Agriculture Extension Service were also used as contacts. Other contacts were Westinghouse Electric Corporation, General Time Corporation, U.S. Navy Supply Corps School, Clarke County Welfare Department, Salvation Army, YWCA, State Jaycees, State Chamber of Commerce, Civic Clubs, Veterans Organizations, and the University of Georgia Alumni Association.

Sixty applications were eventually received, from which nine shelterees were selected. The tenth shelteree, the shelter manager, was a member of the Civil Defense research staff.

The composition of the selected shelteree group was as follows:

Age	Sex	Remarks
8	M	Student
9	F	"
14	M	"
15	M	"
16	F	"
21	F	"
23	M	"
41	M	Father of 8 & 9 year olds
54	M	Employed locally
63	M	Retired Univ. of Ga. Faculty

Table 1

Outline of Pilot Studies
(N = 10 shelterees/study)

	(28-30 Sept.)	(5-7 Oct.)	(12-14 Oct.)
	I	II	III
Shelter Environment			
Space--sq ft/person	10	10	8
--cu ft/person	65	65	52
Temp.--optimal	optimal	optimal	-
--high	-	-	high
--low	-	-	-
Humidity--optimal	optimal	optimal	-
--high	-	-	high
--low	-	-	-
Ventilation	high	high	low
Shelter Equipment			
Water/person/day	ad lib	ad lib	1 qt.
Food/day	biscuits/adjuncts	biscuits without adjuncts	biscuits (370 cal.)
Sanitation	flush toilet	chemical	chemical
Bunk facilities	8 persons	4 persons	0
Blankets/person	3	1	0
Recreational materials	yes	yes	no
Washing water	yes	no	no
Coffee	yes	no	no
Cigarettes	yes	no	no
Shelter Org. & Mgt.			
Staff org.	yes	yes	yes
Handbooks & manuals	yes	yes	yes
Shelter Activities			
In-shelter training	yes	yes	yes
Exercise	yes	yes	no
Age Ranges			
51-70	2	2	0
21-50	3	3	5
14-20	3	3	5
7-13	2	2	0
3-6	0	0	0
0-3	0	0	0

One of those originally selected withdrew because of a daughter's illness, and was replaced.

All selected shelterees expressed personal interest in how he or she would react under shelter conditions. Teenagers were acquainted in that they attended the same high school.

C. Experimental Fallout Shelter and Supplies

Basic characteristics of the simulated fallout shelter at the Psychological Laboratories of the University of Georgia were described in the Quarterly Report for July - Sept., 1962.

Space allotment consisted of ten square feet/person, with an additional one and one-half square feet for storage. The shelter ceiling was 6.5 feet high, allowing 65 cu. ft./person, exclusive of storage.

A flush toilet was connected and available for use.

Water for drinking and washing purposes was provided ad libitum from a sink. Food consisted of the 2½" square 30-calorie sweet survival biscuit (provided by the Civil Defense Supply Division, Defense General Supply Center, Richmond, Virginia), used with adjuncts such as soups, raisins, jelly, peanut butter, and condensed milk. A 25-cup coffeemaker and an abundant supply of coffee was available. Shelterees were allowed to bring cigarettes. Recreational supplies consisted of games, puzzles, playing cards, and books.

For sleeping facilities, the Fabricated Channel Bunking Unit was used. These are manufactured by Storack Corporation, Evanston, Illinois, but were furnished by Quartermaster Research & Engineering Command, U. S. Army, Natick, Massachusetts. One three-tiered, six-man unit was assembled. The ¼" plywood sleeping surface was found to be unacceptable, however, because of weakness. Therefore, ½" plywood was used. Furthermore, the "T" lug and slot were found to be unreliable, and bolts had to be added to insure safety. In addition to these facilities for the six adult shelterees, one cot mattress on the floor was provided for the two children. The remaining two shelterees were to stand watch during the night. The

bunks were not furnished with mattresses, but thirty army blankets and ten pillows were available for use on the plywood bed surface.

Comfortable temperature, humidity, and ventilation conditions were provided throughout the shelter stay. The shelter manager was to request any changes in these variables if desired.

D. Pre- and Post-Shelter Testing

The purpose of the pre-shelter psychological evaluation was first, for descriptive purposes, to determine the pre-confinement level of intelligence and second, to provide a base from which change could be evaluated.

The Wechsler individual intelligence scales were selected for all three pilot studies because they yield a global intelligence score and subscores which have been found to be sensitive to subtle and transitory changes in immediate recall, motor-perceptual speed, rate of new learning, and general mental alertness.

The Minnesota Multiphasic Personality Inventory (MMPI) is one of the most widely used and best research measures of personality. This test yields scores on ten clinical scales which cover such things as generalized physical symptoms, i.e., headaches, nausea, exhaustion, and insomnia, symptoms of depression, suggestions of general anxiety states, conflicts with family or friends, and lack of personal sensitivity to the reaction of others.

The Structured Objective Rorschach Test (SORT) is designed to provide psychologically meaningful data for the analysis of temperament and personality. It combines the subtle features of the Rorschach with practical group methodology. The SORT retains the same stimulus material as the original Rorschach and uses the same scoring system.

After a welcome, and brief orientation, the adult members of the group started the MMPI while the children began medical screening, conducted by the University physician. All psychological tests were administered under standard conditions, although each adult was interrupted on the MMPI in order to take individual tests as necessary in the time schedule. When each person had

finished the medical, physical fitness, and Wechsler intelligence scale, he would return to the main testing room to continue working on the MMPI. The SORT was given as soon as the MMPI was completed. In this manner all members of the group accomplished all five tests in approximately 3½ hours. Because of the reading level of the personality measures, the two children under fourteen were not able to complete the SORT and MMPI.

A thorough review of the recent literature on physical fitness measurement (see Quarterly Report for July - Sept., 1962) indicated that a modification of the Rogers' Performance Fitness Index and the rapid form of the Harvard Step Test might give the best evidence of each individual's physical state and any physical deterioration occurring over a period of shelter confinement. These tests measure grip strength, lung capacity, and cardio-respiratory endurance. The battery was further supplemented by a measure of weight. The physical fitness battery was given to each shelteree immediately before and after shelter confinement. The tests were administered individually in a room adjoining the medical examining facilities.

The post-shelter confinement testing procedure was essentially the same as for pre-shelter. Shortly after their release from the shelter, the adults started the MMPI while the children took the medical and physical fitness tests. Thereafter, each shelteree was taken from the main testing room to complete the individual tests, and returned to the testing room to continue working on the group tests. Most shelterees completed the post-testing battery within three hours. In addition to such tests, several questionnaire forms were completed. (See In-Shelter Testing.)

E. In-Shelter Testing

A forty-five hour program of activities was written as a guide for the shelter manager as well as to furnish outside observers an outline of events. The shelter manager also kept a shelter log, for purposes of recording radiation, floor temperature, ceiling temperature, and oxygen and carbon dioxide readings taken with a Fyrite instrument.

Observers or monitors on 24-hour watch in the observation area surrounding the shelter kept records of water usage and oxygen and carbon dioxide levels. A cumulative log for recording behavioral changes was also kept.

Immediately upon emergence from the shelter, several rating scales and questionnaires were completed by the shelterees, prior to taking the post-shelter physical fitness and psychological test batteries. These forms consisted of (1) a series of items, believed to be potential discomfort factors, which the shelterees ranked on a comparative basis, (2) a rating scale pertinent to the shelter experience and designed to get shelteree evaluation of specific variables relating to training and procedures, environmental conditions, food and equipment, social and psychological factors, (3) a series of sentence-completion items constructed to gain shelteree comment on specific shelter-experience topics, (4) two open-end questions concerned with what the shelterees liked most and least about the study, and (5) sociometric data on shelteree preference of fellow shelterees with whom they would most and least like to share another shelter confinement.

F. Results of the Study

1. In-Shelter Test Results

The study was primarily an instrumentation checkout and therefore environmental conditions were changed periodically to evaluate equipment performance. On two occasions a relay in the air conditioning broke down and was repaired. A fault in the humidifier system was also corrected. The average Effective Temperature (ET) was 70° and the relative humidity averaged 48%. Water usage averaged 10.3 gallons/person, but this included toilet flushing and dishwashing.

Reactions of the shelterees to confinement are best portrayed in their responses to the rating scales and questionnaires. Rankings of discomfort factors are presented in Table 2. It should be noted, however, that the rank of "1" given to "Sleep Conditions" is a <u>relative</u> evaluation. The <u>absolute</u> evaluation of

Table 2

Shelteree Rankings of Discomfort Factors in Pilot Study I

Comparative Ranking	Item
1	Sleep conditions
2	Lack of space
3	Lack of exercise
4	Lack of bathing facilities
5	Food
6	Heat or cold
7	Noise
8	Boredom
9	Humidity
10	Ventilation
11	No interesting activities
12	Outside concerns
13	Value of this research
14	People in shelter
15	Payment for shelter stay

"Sleep Conditions" was measured on the Shelter Rating Scale in terms of the bunks which were given a mean rating of 3.4, interpreted as "O.K." in judgement, and in terms of sleep evaluated as 3.5 or "average" in judgement . Almost all of the items on the Shelter Rating Scale were rated favorably, indicating good adjustment to the shelter stay. Space was evaluated as "no complaint" and the survival biscuit earned a "fair" rating.

Responses to the Sentence Completion Questionnaire were in general accord with those on the Shelter Rating Scale. Responses to the Open-End Questionnaire added further support. Most often mentioned as a "liked-most" factor was the social experience afforded by the study; the "liked-least" factor most mentioned was sleeping conditions.

The sociometric data indicated a usefulness for larger groups, but results did not warrant an analysis here.

2. Pre- and Post-Shelter Test Results

No changes in intellignece scores from pre- to post-shelter testing were expected or found. Similarly, no significant changes in MMPI scores were found. The only change in physical fitness was a mean weight loss of 1.2 pounds.

G. Conclusions

The instrumentation check was basically satisfactory and any indicated adjustments were made prior to Pilot Study II. Appropriate changes were also added to the pre- and post-shelter testing procedures, and in the monitoring procedures.

The survival biscuits used with adjuncts proved quite acceptable during the short confinement period studies. The bunks, lacking mattresses, constituted the primary

complaint factor, but on the absolute rating scale even the sleeping conditions were acceptable. The "T" slot and lug assembly on the bunks proved very unsatisfactory, however. Fittings were mostly too tight or too loose, and the "T" lug was easily sheared off if force was used to insure a snug fit. In the present study, bolts were added for purposes of safety as well as strength. The ½" plywood sleeping surface recommended was also unsatisfactory and unsafe; ½" plywood was used instead.

In regard to food containers, difficulty was experienced in opening the cans with the lift-type can opener. Jagged edges later constituted a medical hazard, met by putting adhesive tape on the sharp edges. It would seem that a metal strip tab, similar to that on coffee tins, would be a more convenient and safe method of opening.

SECTION II

Pilot Study II

Pilot Study II

A. Purpose

Pilot Study II was a replication of Pilot Study I with the additional testing of the following experimental variables: (1) survival biscuits without adjuncts, (2) chemical sanitation facilities, (3) limited bunk facilities, i.e., four bunks for ten shelterees, (4) no washing water, (5) no coffee, and (6) no cigarettes. Space, temperature, humidity, and ventilation were the same as in Pilot Study I (see Table 1 in beginning of report).

B. Shelterees

The ten shelterees for this study were selected from a pool of ninety applications:

Age	Sex	Remarks
12	F	Student
13	M	" (Half-brothers)
14	M	" " "
16	F	"
22	F	Secretary (local industry)
24	M	Cabinet worker
30	F	Secretary, Univ. of Ga.
33	M	Sgt. in Marine Corps (Shelter Manager)
49	M	Training Spec., Univ. of Ga.
52	F	Housewife

The shelter manager was a Marine Sergeant stationed at the U. S. Navy Supply School, Athens, Ga. He received several hours' indoctrination on the nature of the pilot study and the variables under investigation.

Recruiting and application forms were the same as those for Pilot Study I, with the addition of a modified Personal Item Supplement form.

C. Experimental Variables

As noted, space, temperature, humidity, and ventilation were the same as for Pilot Study I. Water for drinking purposes was provided ad libitum in the one-liter plastic bottles of the chemical sanitation kit (No. 40040 Sanitation Kit CD Shelter). The 2½" square sweet survival biscuit (30 cal./biscuit) used in Pilot Study I was again used, but without adjuncts. There was no restriction on the amount available.

The bunks of the first study were not used in the second study. Instead, a four-person four-tier bunk was constructed of Equipto angle iron bolted together. A ½" plywood bed surface was again used. A floor mattress, five pillows, and ten blankets completed the sleeping facilities. Thus sleeping accommodations for five persons were furnished, although the ten shelterees could utilize them in any desired manner. Recreational materials similar to those in Pilot Study I were included in the supplies as well as a No. 00090 Medical Kit Shelter "A". No coffee or cigarettes were available in the shelter and none were brought in by shelterees. No washing water was allowed, but hand towelettes and hand cleaner were provided.

D. Pre- and Post-Shelter Testing

The battery of psychological and physical fitness tests used in Pilot Study I was again used in Pilot Study II. The post-shelter questionnaires and rating scales were modified and are discussed under "In-Shelter Test Results."

E. In-Shelter Testing

A shelter manager guide for the forty-five hour confinement period was a modified version of that used in Pilot Study I. The schedule was organized along lines of suggested activities for the group. A shelter log was also kept, for purposes of recording water consumption, oral temperature, and radiation, oxygen, and carbon dioxide readings.

Staff monitors stood watches around the clock, recording instrumentation readings, and behavioral changes

in the shelterees.

F. Results of the Study

1. In-Shelter Test Results

Instrumentation functioned more effectively in this study, and no breakdowns occurred. The average ET was 73° and the relative humidity averaged 68%.

The shelterees consumed an average of 740 calories of biscuits/day and 1½ liters of water/day. The chemical commode began to leak early in the study; a glass bottle of Sanitor fluid was accidentally broken and the debris thrown into the commode, perforating the plastic liner and causing leakage. The consequent seepage through the cardboard drum caused the commode to sag in accordion fashion. However, the shelter manager encased the entire assembly in a spare plastic liner and the commode was utilized for the remainder of the study. A generous amount of Sanitor fluid was used, and there was no detectable odor from the commode at the end of the study.

Shelter evaluation of their confinement was obtained on the post-shelter rating scales and questionnaires. Five items were added to the discomfort scale: chemical toilet, lack of coffee and cigarettes, chemical towels, and bottled drinking water. Items in the shelter rating scale pertaining to food toppings and cooking equipment were deleted. The sentence-completion and open-end questionnaire forms were not altered.

Discomfort scale rankings are presented in Table 1. It should be noted here, as in Pilot Study I, that these rankings are on a relative scale. For example, even though "Food" is listed as the highest discomfort item, this item was given a mean rating of "4.6" or "fair" on the shelter rating scale. Again, bunks, although high on the discomfort scale, were given an "O.K." on the rating scale. An examination of other items on the rating scale indicates that none of the confinement variables appeared to be stressful. The sentence-completion and open-end questionnaires indicated a good adjustment, with expected criticisms of food and bunks.

Table 1

Shelteree Rankings of Discomfort Factors in Pilot Study II

Comparative Ranking	Item
1	Food
2	Lack of bathing facilities
3	Sleep conditions
4	Drinking water
5	Ventilation
6	Lack of space
7	Heat or cold
8	Noise
9	Chemical toilet
10	Outside concerns
11	Chemical paper towels
12	Boredom
13	Lack of coffee
14	Lack of exercise
15	Humidity
16	No interesting activities
17	Lack of cigarettes
18	Payment for shelter stay
19	People in shelter
20	Value of this research

2. Pre- and Post-Shelter Test Results

No significant changes were found in either the psychological or physical fitness test scores, with the one exception of a mean weight loss of 3.5 pounds.

G. Conclusions

Instrumentation and observer procedures were more successful in Pilot Study II. Reactions of shelterees to the experimental variables involved indicated good adjustment and only minor stress. With regard to equipment, the shelterees adjusted well to sleeping on plywood bunk surfaces with only a blanket and pillow. There was good adjustment to the chemical commode, although it seems that glass containers should be replaced with plastic, to preclude the possibility of broken glass being discarded into the commode, resulting in liner damage and leakage.

SECTION III

Pilot Study III

Pilot Study III

A. Purpose

Pilot Study III differed considerably from Pilot Study II, in that very high stress variables were introduced. An attempt was made to approximate severe physiological limitations with a civilian sample.

B. Shelterees

On medical advice, the age limit of the shelteree group was restricted to 14-50 years. Shelterees were selected from a pool of one hundred volunteers. Several standbys were available in event of necessary substitution prior to shelter entrance; however, all ten originally selected applicants were used. The composition of this group follows:

Age	Sex	Remarks
14	M	High school student
16	F	" " "
19	F	Secretary, industry
21	F	Psychology student
22	M	Law student
30	M	Civil Defense Research staff member
36	M	Farmer, lumberer
37	F	Nurse
40	F	Secretary, Univ. of Ga.
42	M	Draftsman

A nurse was selected as a shelteree as a precautionary medical consideration.

C. Experimental Variables

Space allotment/person was 8 sq. ft. (52 cu. ft.) with an additional 1½ sq. ft./person for storage.

Temperature was set 74° d.b. upon shelter entry, then raised to 90° d.b. within the first three hours, maintained at this level for the next thirty-seven hours, then reduced to comfortable levels for the last four hours of confinement. The ET for the middle thirty-seven hours was 81°, which produced considerable perspiration and verbal complaints from the shelterees. Ventilation was set at 15 cfm/person, of which 3 cfm was fresh air and 12 cfm recirculated air. The illumination of the shelter was under control of the shelterees.

Drinking water was rationed at one liter/person/day, and food rationed at 370 calories/person/day. Shelterees were instructed, however, to get by on as little water and food as possible, even less than the rationed amount, if possible. The rationale for the one liter of drinking water/day was based on medical advice. The daily ration of 370 calories/person was selected as being one-half of the food consumed daily ad libitum in Pilot Study II.

The cardboard drum chemical toilet of Pilot Study II was replaced by an empty metal 17.5 gallon CD water drum, to preclude leakage. The supplies, however, in the chemical sanitation kit of Pilot Study II were again used. No bunks, pillows, or blankets were provided; the shelterees were to sleep on the concrete floor of the shelter. No recreational supplies were provided, nor coffee or cigarettes. No water for washing was included, but hand cleaner and paper towels were available

D. Pre- and Post-Shelter Testing

Psychological and physical fitness testing were similar to the previous pilot studies.

Added to the routine forms of rating scales and questionnaires used in the first two pilot studies were: (1) a multiple-choice, twenty-item examination on shelter training topics; (2) a semi-structured interview with each shelteree upon emergence from the shelter; and (3) a semi-structured interview with each shelteree when he reported one week later to be weighed and receive his payment for participation in the study. The earlier forms were again modified slightly to make them applicable to the new environmental conditions.

The discomfort scale was identical to that employed in

Study II with the exception of an item pertaining to chemical paper towels, which did not apply to the Study III situation.

E. Results of the Study

1. In-Shelter Test Results

As noted in the discussion of the experimental variables for this study, the ET was maintained at 87° for all but the preliminary and terminal hours of confinement. The lighting level was adjusted by the shelterees within the range of 60-180 watts during waking hours and 10-20 watts during sleeping hours. The latrine light was set at 10 watts and could not be changed within the shelter, nor the 7.5 watt light illuminating the shelter side of control booth observation window. The purpose of the latter light was to increase the difficulty of shelterees seeing through this one-way window into the central control booth.

The high temperature and humidity were severe stress variables in the present study. Headaches were a frequent complaint. Toward the end of the study, several female shelterees manifested dizziness, palpitation, faintness, rapidly changing pulse, and other signs of heat stress. The nurse in the shelter at one time requested removal of a shelteree, but the latter insisted on staying and managed to remain to the end of confinement. The temperature and humidity variables most probably interacted with the reduced food and water factors to induce even greater stress than would be induced by these variables operating singularly. The shelterees were requested by the shelter manager to subsist on as little food and water as possible. The consequent water consumption averaged 3/4 liter/person/day, and food consumption averaged 293 calories/person/day.

Discomfort scale rankings for Pilot Study III are presented in Table 1.

Sleep conditions received the highest discomfort ranking, followed by heat as second (the discomfort scale is marked "Heat or cold" in reference to future possible studies evaluating reactions to low temperatures). On the Rating Scale, sleep earned an average

Table 1

Shelteree Rankings of Discomfort Factors in Pilot Study III

Comparative Ranking	Item
1	Sleep conditions
2	Heat or cold
3	Lack of space
4	Humidity
5	Lack of bathing facilities
6	Lack of exercise
7	Ventilation
8	Food
9	Drinking water
10	Chemical toilet
11	Boredom
12	Outside concerns
13	No interesting activities
14	Noise
15	Lack of coffee
16	Value of this research
17	Payment for shelter stay
18	Lack of cigarettes
19	People in shelter

rating; temperature and humidity, however, were rated low in comfort. Space, although number three on the discomfort scale, was given an average evaluation of no complaint on the rating scale.

Comparison of the discomfort scale and the rating scale, therefore, indicates that temperature, space, and sleeping conditions were the greatest sources of discomfort.

The social items of the rating scale were uniformly rated very high. The shelterees evidently enjoyed each other's company and highly valued their social interaction.

The sentence-completion questionnaire results appear to indicate some specific attitudes and opinions not obtained by other measures. Shelter biscuits, for example, were considered "good" by six shelterees and "very good" by four. One subject volunteered that "the more I ate the better they got." Shelterees appear to dislike the physical discomfort (soreness) incurred by the sleeping conditions rather than the conditions per se. The warmth and plastic taste of the water were mentioned rather than the amount supplied or the means of storage. Comments on temperature vary from definite feelings that it was too warm to statements evidencing mild discomfort. Generally, the sentence-completion items are answered in a general rather than specific manner.

Responses to the open-end questions concerning most- and least-liked factors in the study, not included here, reveal the social aspects of the experiment to be most favorable, with a notable number of shelterees also commenting positively on the knowledge and training afforded by the situation. Sleeping on the floor was by far the least-liked aspect of the study, with minimal mention made of other negative aspects.

Singular to this pilot study was a twenty-item multiple-choice examination intended to measure the information shelterees acquired as a result of their confinement. Scores ranged from 45 to 90, with a mean of 73. The maximum score possible was 100.

Also introduced in this study was a semi-structured post-shelter interview with each shelteree.

Little information was gained via this method that did not appear in other measures, although the interviews did substantiate insights revealed by other methods--namely, the discomfort of sleeping conditions (i.e., the hard floor), the fact that many of the shelterees anticipated more severe conditions than actually experienced, and the feeling of lethargy and drowsiness during confinement. Without exception, these shelterees reported that they could have endured these same shelter conditions for at least a week, and longer if necessary.

A week following the date of shelter entrance, each shelteree reported to the Psychological Laboratories to be weighed and to receive their pay. At this time they were questioned briefly concerning their appetite, sleep, emotional reactions, endurance, concentration and general health. The shelterees had gained back most of the weight lost over their shelter week-end. Most of them reported a lack of appetite on the day of shelter emergence, a general soreness from sleeping on the floor, and tiredness or inability to concentrate lasting one or two days. All persons reported deep and lengthy sleep on the night following their confinement.

2. Pre- and Post-Shelter Test Results

As in the previous pilot studies, no significant changes occurred. The only significant change in physical fitness was an average weight loss of 4.8 pounds.

F. Conclusions

It was felt that the conditions of Pilot Study III approximated the limits of psychological tolerance without medical attention. Heat prostration would have likely occurred in some shelterees if the experiment had been continued several hours. To prevent such an occurrence was the primary reason that temperature and humidity conditions were alleviated four hours prior to termination of confinement; secondarily, it was planned to gradually acclimate the shelterees to outside temperatures as to prevent sudden

chilling upon exit. It should be remembered that shelterees in the present study were civilians, of average health, ranging in age from 14 to 42, involving women and young people, who were subjected to stressful sleeping conditions, on reduced rations, and that such variables are expected to interact with the temperature and humidity variables in such a manner as to be more stressful than temperature and humidity evaluated alone.

SECTION IV

Summary and Forecast

A. Summary of Research Findings

1. Instrumentation

Instrumentation in the three pilot studies seemed basically satisfactory. Slight modification and improvements will be made for future studies.

2. Shelteree Reactions to Shelter Confinement

Although rating scales and questionnaires were administered during post-shelter testing, the information obtained is relevant to in-shelter testing and is therefore summarized here.

On the discomfort scale, high uniformity in ranking some items is evident. Sleep discomfort was ranked high in each of the three studies. Value of research, people in shelter, and monetary remuneration were ranked low in discomfort in each study. With increased degree of discomfort in the general environment, as in Study III, high discomfort items (i.e., sleep conditions and temperature) were given consistently high rankings. Spread of the mean rankings for each scale increased with increased stress factors of the environment. Spread of Pilot Study I is 2.9-12.4. Pilot Study II is 4.2-17.3 and Pilot Study III is 1.3-16.2. With greater stress conditions, there is greater uniformity of agreement, i.e., less variance in group ratings.

The decreased importance of food in Pilot Study III is revealing. With only an average consumption of approximately 300 calories of biscuits and a liter of water/day, food and water discomfort were ranked relatively low. Temperature and sleeping discomfort were apparently great enough to negate food and water discomfort. Upon emergence from the shelter, all subjects said that they were not particularly hungry or thirsty. They did want a drink of cool water, however, complaining of the warm and plastic-flavored water in their canteens. Lack of bathing facilities was one of the higher discomfort factors in all studies.

In Pilot Study I, when planned periods of exercise were rejected by shelterees discomfort incurred by lack of exercise is ranked high, whereas in Pilot Studies

II and III, (when exercise periods were part of the program) this factor is given lower discomfort ranking by shelterees.

Boredom and lack of interesting activities do not appear to be primary discomfort factors in these three studies. Shelterees in Pilot Studies I and III give relatively low rankings to these factors.

As stress factors increase, noise as a factor diminishes in felt discomfort, though this may be due to a change in noise-producing factors rather than a manifestation of variable effects.

The chemical toilet, utilized in Pilot Studies II and III, receives a somewhat higher discomfort ranking in Pilot Study II than in Pilot Study III, possibly because the apparatus began to leak in the second study.

Though space/person decreased in the three studies, its mean ranking as a discomfort is highest in Pilot Study I, where shelterees had most space, it diminishes as a discomfort in Pilot Study II, and rises somewhat in Pilot Study III.

Shelterees in Pilot Studies II and III were not allowed to have coffee or cigarettes. In neither study do these deprivations receive higher discomfort rankings, though coffee lack in Pilot Study II was ranked as more of a discomfort than cigarette deprivation. In Pilot Study III, both coffee and cigarettes were ranked low in discomfort. Of course, this aspect of discomfort will vary in any circumstance as the group composition varies, for the caffeine and nicotine habits prior to shelter experience will affect discomfort felt from deprivation within the shelter.

Discomfort rankings along the male-female dimension reveal little variation from the over-all picture. For all shelterees in all three studies the discomfort of sleep conditions is a constant high-ranked factor. Males tend to rank boredom and/or lack of interesting activities somewhat higher in discomfort than females. Females in Studies II and III evidence greater discomfort incurred from the chemical toilet facilities; and the lack of bathing facilities also seems to be a greater discomfort factor for women.

The discomfort rankings present a picture of the relative discomfort of one factor when weighed against other potential factors of discomfort. Hence the rank-

ings discussed above are not considered on a *per se* basis, but rather within a universe of other related items.

Sentence-completion items and abbreviated responses are generally surface and unclassifiable for any meaningful insight. Since no adequate means of classifying this type of information is readily manifest in response patterns and responses are for the most part lacking in depth, the use of such a measure is contraindicated.

The open-end-questionnaire data reveals a greater uniformity of situational dislike with increased environmental stress variables. All three pilot studies reveal that the aspect of the experiment liked most was the social stimulation afforded by members of the group and the knowledge and experience received from participation

Specific aspects of the shelter experience and environment were evaluated by shelterees via rating scales. Shelteree ratings on these scales tend to be more or less undifferentiated from one study to another.

Rating items were classified under the following headings: training and procedure, environment, food and equipment, social, and psychological. The greatest variability in rating of items is evidenced in the environmental categories. Conversely, the greatest unanimity is evident in the social category.

Temperature, humidity, and ventilation were all ranked as less comfortable by participants in Pilot Study III than by those in Pilot Studies I and II. The survival cracker was ranked excellent by shelterees of Pilot Study III, whereas only a fair rating was given this factor by individuals in Pilot Studies I and II. General health was ranked average by shelterees in Pilot Study III and ranked good by those in Pilot Studies I and II. General comfort in shelter was rated lower in Pilot Study III than in the two previous studies.

Sociometric data from Pilot Study I were unreliable to the extent that two children did not complete their preferences, and it is also quite possible that the shelter manager was not considered in the ranking preferences by the remaining shelterees.

Sociometric data from Pilot Study II revealed positive choice preference among the shelterees for the shelter manager and secondary positive preference for the two oldest shelterees. Negative choices were shared

primarily by the youngest members of the group.

In Pilot Study III, the positive choice was again the shelter manager with a teen-age girl sharing a close second. The negative choice pattern focused on one shelteree (limited by the absences of choices from three shelterees).

It is anticipated that the sociogram data will be more revealing with a greater N and with longer duration of shelter confinement.

The Multiple Choice Examination scores in Pilot Study III were not considered of any essential importance, since the shelter manager used the examination directly in group discussions. It does reveal, however, that shelterees did retain much of the general-type knowledge with reference to shelter life.

Post-shelter interviews conducted in Study III contributed relatively helpful insight into the confinement experience, though major points emphasized via this means tend to overlap with information gained through other techniques of assaying the shelter experimentation.

3. Pre- and Post-Shelter Testing

In intelligence testing, the mean full-scale WAIS I.Q. was 110 with no shelteree scoring below 96. The mean for the children on the WISC was 104. Even the maximum stress conditions of Pilot Study III seem to have had little overall effect on the general level of mental alertness of shelterees. Immediate recall, motor-perceptual speed, and rate of new learning showed no significant change from pre to end testing. Speed and accuracy of arithmetical computation seem to suffer some slight loss between the two test periods.

Analysis of the pre-shelter confinement personality measures indicates that the shelterees were well within the normal range although slight elevations did occur on several scales. Overall, the shelterees appeared to be lacking in deep emotional response and concern for social customs, as well as being vigorous and somewhat over-productive in thought and action. As might have been expected, the changes in personality from pre- to post-shelter confinement were minimal as reflected by the MMPI; however, in some individual cases changes

were suggestive of what might be expected over longer stress periods. Girls and women in all three pilot studies seemed to be more aggressive, socially extratensive, self confident, and without obvious conflict, then were the male shelterees. On the other hand, upon leaving the shelter some boys and men seemed to be more introvertive, self conscious, and socially insecure then they had been at the time of the pre-testing.

As was apparent from the results of the individual intelligence scale, the SORT confirms the fact that the subjects for the three pilot studies were above average in the ability for thinking in broad, general and abstract terms. They were able to concentrate on the task at hand and to avoid environmental distractions. In spite of the maximum physical stress of Pilot Study III, there was little excessive worry or evidence of manifest anxiety. There was a shift toward increasing control of emotional energy, and a decrease in empathic tendencies.

Only a very limited number of cases showed an absence of willingness to work for the interest of the group. Shelterees recognized their social responsibility and obligation to follow reasonable directions of the shelter manager.

Evidence of moodiness was absent. All groups were able to maintain consistent, stable interpersonal relationships. Individual members were flexible; they could both give and take group-approved actions.

The physical fitness test battery seemed adequate for further use and verification with larger groups of shelterees over longer periods of time.

B. Forecast

Even though Experimental Study I, the first of a series, was conducted 14-18 December, 1962, it is discussed here under "Forecast", since final analysis and report of this study is to be included in the Quarterly Report for January - March, 1963.

The design of Experimental Study I was based on findings of Pilot Studies I, II, and III. Duration of shelter confinement was four days, and the study was primarily a replication of Pilot Study III over a longer time period

with a larger number of shelterees (see Table 1). High temperature and high humidity was not introduced, however, to avoid confounding these stress effects with those of low calorie diet and low water supply with shelterees in the age span of 15-50 years. Designs for subsequent experimental studies will be contingent on the evaluation of Experimental Study I and each successive study in turn.

Table 1

Outline of Experimental Study I

14-18 December, 1962

Shelteree Characteristics

Number--30, including a trained shelter manager and a medic
Age--15 to 50
Sex--15 females, 15 males

Shelter Environment

Space--8 sq. ft./person (52 cu. ft./person)
--1 cu. ft./person storage additional
Temperature--optimal
Humidity--optimal
Ventilation--15 cfm/person (3 cfm fresh air, 12 cfm recirculated air)
Confinement--4 days

Shelter Supplies

Water--1 qt./person/day
Food--300 cal./person/day (Bulgur Wafer)
Sanitation--Sanitation Kit III
Medication--Kit A
Radiological Kit
Bunks--none
Blankets--none
Recreational Materials--none
Washing Water--none
Coffee--none
Cigarettes--none

Appendix C

Experimental Study I

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I. Abstract

On 14-18 December, 1962, a four-day simulated community fallout shelter study was conducted at the Psychological Laboratories of the University of Georgia. Thirty shelterees, 15 males, 15 females, from 15-50 years, participated. Space allotted was 8 sq. ft./person; ventilation consisted of 15 cfm/person; temperature and humidity were optimal. Shelter rations consisted of 300 cal./person/day of Bulgur wafers without adjuncts, and 1 qt./person/day of drinking water. Sanitation Kit III and Medical Kit A were used. Shelterees slept on a concrete floor. There were no provisions for bunks, blankets, recreational materials, washing water, coffee, or cigarettes.

Eight shelterees defected during the study. The remaining shelterees predicted they could endure two more days of confinement before feeling compelled to leave. However, shelterees completing the study emerged in relatively good physical, mental, and psychological condition.

II. Experimental Design

A. Purpose

Experimental Study I was a four-day study designed to test the conditions of austerity outlined in Table 1. These conditions involved thirty men, women and children, living in close confinement, sleeping on the floor, and subsisting on severe rations of food and water.

B. Experimental Variables

Space allotted was 8 sq. ft. and 52 cu. ft./person, with an additional 1 cu. ft./person for storage. Temperature and humidity were optimal, and not introduced as stress variables in this study to avoid confounding such stress effects with those of low caloric diet and low water supply, particularly with shelterees in the age span of 15-50 years. Ventilation was maintained at 15 cfm/person (3 cfm fresh air, 12 cfm recirculated air). Experimental Study I was basically an extended replication of Pilot Study III (see Sept. - Dec., 1962, Quarterly Report) with the exclusion of heat stress.

The supplies were OCD issue. Water was stocked in two 17.5 gal. metal drums, to be rationed at 1 qt./person/day. The only available food was contained in two cans of Bulgur

Table 1

Variables Evaluated in Experimental Study I
(14 - 18 December, 1962)

Shelteree Characteristics

Number--30, including a trained shelter manager and a medic
Age--15 to 50
Sex--15 females, 15 males

Shelter Environment

Space--8 sq. ft./person (52 cu. ft./person)
--1 cu. ft./person storage additional
Temperature--optimal
Humidity--optimal
Ventilation--15 cfm/person (3 cfm fresh air, 12 cfm recirculated air)
Confinement--4 days

Shelter Supplies

Water--1 qt./person/day
Food--300 cal./person/day (Bulgur Wafer)
Sanitation--Sanitation Kit III
Medication--Kit A
Radiological Kit
Bunks--none
Blankets--none
Recreational Materials--none
Washing Water--none
Coffee--none
Cigarettes--none

wheat biscuits, to be rationed at 300 calories/person/day. One Sanitation Kit III, one Medical Kit A, and one Radiological Kit completed the official supplies. Four eight-inch candles, matches, a small bookcase, two Bibles, a small fire extinguisher, a Fyrite kit, and a large plastic garbage can were also part of the shelter supply inventory.

Bunks and bedding were omitted as in Pilot Study III. There were no blankets or mattresses available to the shelterees, who slept on the concrete floor. There were no recreational materials, coffee, cigarettes, or washing water provided.

Illumination level was controlled entirely by shelterees.

Clothes, toilet articles and other items brought in by shelterees were limited to the following:

1. Clothes worn
   - Leisure indoor slacks or trousers
   - Shirt or blouse
   - Undergarments
   - Shoes and stockings
   - Handkerchief
2. Toilet articles
   - Only small items such as handbag cosmetics and/or items normally carried on one's person.
3. Items specifically excluded
   - Food
   - Candy or chewing gum
   - Books or magazines
   - Soap
   - Eating or cooking utensils
   - Pillows or blankets
   - Cigarettes or tobacco

C. Shelterees

Details of the recruitment procedure have been described in previous quarterly reports.

The thirty subjects were drawn at random from 165 applications which had been stratified by age and sex. The age

range of the 15 women was from 15 to 47, median age 30 (see Table 2). For the men the range was from 16 to 50 with a median of 27. Thirteen of the male shelterees were selected from the applicant pool. The shelter medic and the shelter manager were volunteers from the University of Georgia Medical School and the School of Veterinary Medicine.

For both men and women, the median level of education was somewhat above the national average. The typical shelteree had completed high school. There were, however, two men of borderline literacy and four college graduates, including, of course, the shelter medic and the shelter manager. In terms of occupation, the range among the shelterees was wide. A truck driver, prison guard, two salesmen, an electrician's helper, and two unemployed male adults were among the shelterees taking part in the study. Several women had regular jobs; most were either students or housewives.

D. Pre- and Post-Shelter Testing Procedures

1. Medical Examination

In addition to questions on general health included in the shelteree application form, a medical examination was administered to each shelteree before and after confinement. This examination was given first followed by Physical Fitness Testing and Psychological Testing.

2. Physical Fitness Testing

The Physical Fitness Testing Battery has been described in detail in the Sept. - Dec., 1962, Quarterly Report. Briefly, it consists of measures on weight, lung capacity, grip strength, and cardio-vascular condition

3. Psychological Test Battery

On the basis of the results of the three pilot studies, the psychological test battery for Experimental Study I was slightly modified and expanded in some areas. The essential features of the individual Wechsler scales were retained, but most of the psychologicals used were of the group type. For evaluating reasoning, both verbal and numerical sections of the Differential Aptitude Test were used. In an effort to detect possible changes in

Table 2

Characteristics of Shelterees in Experimental Study I

Sex	Age	Education in years	Occupation
F	15	12	Student
F*	16	11	"
F	20	14	"
F	20	14	"
F	24	16	Housewife
F	28	12	"
F	29	13	Medical Technologist
F	30	12	Secretary
F*	35	11	Sewing Machine Operator
F	38	12	Housekeeper
F	39	13	Housewife
F	44	8	Clerk, Stenographer
F*	45	16	Home Demonstration Agent
F	46	9	Housewife
F*	47	12	Salesclerk
M	16	9	Student
M	16	10	"
M*	19	10	Salesclerk
M*	19	10	Unemployed
M	20	10	"
M	25	15	Student
M	24	18	" (Med.)
M	27	18	" (Vet.)
M	29	14	"
M	30	14	Unemployed (?)
M	44	8	Salesman
M	35	14	Student
M*	48	12	Construction Worker
M	50	4	Prison Guard Construction Worker
M*	50	6	Truck Driver Electrician's Helper

*Defected during study

the shelterees' ability to perceive spatial relationships, the Minnesota Paper Form Board was added.

The Minnesota Multiphasic Personality Inventory (MMPI) was retained. This test yields scores on ten clinical scales which cover such generalized symptoms, as headaches, nausea, exhaustion, insomnia, depression, and suggestions of general anxiety states, conflicts with family or friends, and lack of personal sensitivity to the reactions of others.

The Structured Objective Rorschach Test (SORT) was also retained to provide psychologically meaningful data for the analysis of temperament and personality. This test combines the subtle features of the Rorschach with practical group methodology. The original inkblots and scoring systems are retained.

4. Pre-Shelter Questionnaire

A Shelter Entrance Questionnaire was administered prior to shelter confinement to obtain information on reasons for shelter participation, expectancies of shelter life, and family preparedness for a nuclear emergency.

E. Behavioral and Environmental Measures

1. Observers and Observational Forms

A team of three observers were on duty from 8 A.M. to 12 midnight, and two observers on watch from 12 midnight to 8 A.M. Each watch interval was of four hours' duration and no observer was assigned two consecutive watches. All observers were staff members or graduate students in psychology.

The chief observer was stationed in the main control room with duties primarily of monitoring automatic recorders, heating and ventilation equipment. He also monitored tape recording of shelter conversations and commented on events internal and external to the shelter.

The second observer was relatively free of structured duties. His main occupation was that of keeping a continuous log of shelter life.

The third observer recorded specific activities and positions in terms of frequency counts of the number of individuals engaged in these activities or assuming these positions. The frequency observations were made at 15-minute intervals on a standard form.

The third observer also sampled wet and dry bulb temperatures from a central location of ten remote thermistors. This sampling was performed hourly. Once every four hours this observer took O_2 and CO_2 readings of air samples from the shelter exhaust duct.

2. Environmental Measures

Environmental measures taken during the study included shelter temperature changes, humidity variations, general activity levels, noise levels, and lighting variations.

F. In-Shelter Program

1. Shelter Manager Training

The shelter manager selected for this study was a 27-year-old veterinary school student with previous employment experience as a physical education teacher and as a highway patrol officer. He received ten contact training hours with the Civil Defense Research staff and spent several additional hours reading and preparing on his own initiative. Training topics included (a) general Civil Defense information, (b) former research efforts, (c) present experimental design, (d) shelter supplies, equipment, and procedures, and (e) unique aspects of shelter command and areas of responsibilities.

2. Activity Program

No detailed time schedule of in-shelter activity was intended. The shelter manager training included the specification of immediate requirements, such as the preparation of the chemical commode and the establishment of an organizational structure of responsible deputies to handle detailed routine such as

food and water distribution. Training periods were to occur at appropriate times, when the greatest number might benefit and when need for an organized activity such as training became apparent. The first several hours of shelter occupation were to be occupied by explanation of the situation and available equipment. The shelter manager was to handle further scheduling from his view of the situation. Within reasonable limits, the schedule in the shelter was to evolve on the basis of a democratic process. Supervision and control of this schedule was almost entirely in the hands of the shelter manager.

III. Results

A. In-Shelter Test Results

1. Experimental Variables

Food was rationed at 356 calories/person/day (four Bulgur wafers, @89 calories). Food consumption averaged approximately 315 calories/person/day. Water was rationed at 1 quart/person/day (six 6-ounce cups). The shelterees as a group drank 7.2 quarts over their ration; this excess was primarily due to a "water raid" on the evening of the third day (see discussion of shelter events). Two commodes were sealed off during the study, the second partially full. Other experimental data are discussed below under appropriate sections.

2. Shelter Events

The following narrative summary describes shelter events in chronological sequence:

Friday Dec. 14 1300-1600	Entered shelter 1735. Number 10 left the Laboratories unannounced immediately prior to entrance and was replaced by #32 (a high school student). The SM assumed

his role by appointing assistants, preparing the chemical commode, and introducing himself and the shelterees to each other. Several CONELRAD messages were received with little or no facial expression.

1600-2000 All Ss listened attentively to outline of procedures and description of equipment by the SM. The men occupied one side of the shelter and the women occupied the other. Several sleeping arrangements were tried, but no conclusion as to best arrangement was reached. Water and biscuits were distributed at 1730. Playing cards were made from white paper and two card games were underway at 1740. The SM assigned watches at 1750. Group singing, conversation, and joking continued to 2000. No comment on CONELRAD messages received during this period.

2000-2400 Five couples began mixing socially in center of shelter. Water and food were distributed at 2005. A CD lecture (45 minutes) at 2030 was well received and stimulated discussion. Diary forms were passed into the shelter, completed and passed out. Lights were turned down at 2200 and all Ss stretched out on the floor wherever they had been sitting. Talking and laughter continued for 45 minutes.

Saturday Dec. 15 2400-0400 At the beginning of the watch, all Ss appeared to be sleeping. Several couples were huddled together and holding hands. Some complaints were made of cold temperature.

0400-0800 The group was restless and only about half of the shelterees were sleeping at any one time. Several couples were again observed lying close together and intimate. Upon awakening (between 0700-0800), conversation focused upon cigarettes, bathing, food, and sleeping conditions. Three shelterees composed a humorous poem on shelter living.

0800-1200 (Two defections at 0930) Water and wafer distributed at 0800. At 0818 the SM phoned the observers indicating Ss #30 and #6 wanted to leave. Number 30 did not feel well, and #6 just "wanted out." The SM was informed that they would be released in a half hour. The medic took temperatures of all shelterees. At 0900 a CONELRAD message was received with indifference. At 0930 Ss #30 and #6 were released,

and the movable wall was adjusted to compensate for the excess space. A first aid lecture was presented at 0955. At 1100 the SM called observers and complained of a draft coming in under the movable wall.

1200-1600 (Four defections at 1530) Almost all Ss were observed lying down after lunch. About 1500, the SM called the observers and indicated that four Ss wished to be released. The observer told the SM he would return his call in thirty minutes. At 1530, #4, #25, #26, and #29 left the shelter. The movable partition was changed to compensate for space, and blankets were placed along the crack at the floor to seal off the draft. Number 3 burst into tears at 1600. The medic alerted the observers to her possible exit, and at 1430 indicated she would stay no longer.

1600-2000 (One defection at 1657) At 1630, interview with #25 completed. Group singing at 1645 as if to relieve #3. At 1657 SM and medic decided to release #3.

2000-2400 Temperatures taken at 2030. Diaries were completed at 2100. Number 32 (high school student) read a short story to the group (5-10 minutes). At 2125 the lights were dimmed. A few complaints of cold temperature were heard. At 2300 observers raised illumination level from control booth to attenuate romantic activities. At 2400 the shelter was quiet and everyone appeared to be sleeping.

Sunday
Dec. 16

2400-0400 All appeared quiet until 0300 when there was a brief interval of conversation. Discussion quieted down at 0400.

0400-0800 Uneventful. Almost everyone asleep through the watch. Number 28 and #9 were most restless and sat up most of the night. At 0700 shelterees began to stir and awaken.

0800-1200 A 5-minute religious observance was held at 1000. This was composed of one hymn and a Bible reading. A CONELRAD message at 1100 received mild attention. At 1155 lunch was served. During this watch period, activity was relatively high from 0800 to 1000. From 1000 to 1145 most Ss were lying down.

1200-1600 At 1210 the medic called the outside medic. After lunch random conversation and a reading by the shelter medic from one of #32's textbooks. At 1240 the reading was over, and the lights were turned down completely at 1256. The lights were dim until 1400. The shelter was very quiet and two couples were observed lying very close. General activity was high toward the end of the watch. A report by the medic indicated his observance of personal and observed hostility concerning relatively minor events. He also indicated that thirst was becoming a more important consideration.

1600-2000 (One defection at 1707) At 1600 there was much conversation and laughter. Conversation centered upon food and eating establishments. At 1700 the shelter medic consulted with the external medic concerning #17. At 1707 #17 left the shelter. The group immediately resumed their conversation and joking. At 1815 water and food rations were distributed. (A post-shelter interview with the medic revealed that sometime during this watch a "water-raid" was initiated, wherein several shelterees, including the medic, drank excessively from the water drum. The primary objective, according to the medic, was to consume the amount of water remaining in the first water drum so that it could replace the chemical commode in use, which was about two-thirds full and beginning to smell. The medic was under the impression a record of this raid was kept, but no record was found in post-shelter inventory. The medic stated the raid took on a humorous aspect, in that it seemed as though, no matter how much they drank, they would never "get to the bottom of that 17.5-gallon container!" It appeared, therefore, that the water raid was not intended to transgress the water ration limit, although in fact it did.) The shelter manager was quite inactive during the latter part of the watch.

1825 Number 17 was removed on the advice of the shelter medic. Symptoms of crying, tightness of the throat, hyperventilation, and vertigo.

2000-2400 The Project Director called the SM, informing him that shelterees should follow the highest standards of public behavior, which precludes overt romantic activities. SM was left to own discretion in handling this problem. He later announced to the group that the sleeping arrangements would be segregated by sex. There was no immediate reaction, though at 2030 there was a great deal of boisterous laughter and joking as if a delayed response. Lights were dimmed at 2040. From 2040 to

2200 any act or statement of any member of the group on any topic evoked continuous loud and hilarious laughter, similar to hysterical laughter.

Monday Dec. 17 2400-0400 At 0013 several comments were noted concerning warm temperature by several people. There was a procession of shelterees to and from the latrine. At 0242 the medic lightly punched a near-by lightly-snoring shelteree. There was very little activity during this watch and it was remarkably quiet.

0400-0800 Quiet. At 0720 lights turned up. Many comments on soreness, and most shelterees appeared in amiable mood.

0800-1200 A brief exercise session was held at 0928. Temperatures were taken after breakfast. The medic appeared to be feeling poorly. Very little interest or response to CONELRAD. The lights were dimmed at 0935 until 1100. Lunch served at 1155. There was a great deal of conversation from 1100 until noon. Group appeared to be in good spirits. The second drum of water was opened during this watch. The empty first drum had been converted to a chemical commode.

1200-1600 There was conversation about food following lunch at noon (consisting of one cup of water and one wafer). The SM began a 30-minute examination of the radiation kit. The temperature rose at one point during this period. Quiet reactions and statements about heat. Temperature was lowered and there was an increased amount of activity. After a short period of quiet there was general conversation. At 1600 Ss lined up for water and wafer.

1600-2000 Generally relaxed atmosphere, shelterees in good spirits. There was some discussion and activity. Number 32 appeared a little tired and less alert. There was spontaneous singing. Discussion. Exercising. Water and food were passed out at 2000. Number 15 appeared depressed during early watch. Medic and #9 took temperatures.

2000-2400 Excellent spirits. SM lectured on radiation. High interest shown by the shelterees.

Tuesday Dec. 18 2400-0400 Complete inactivity. Number 16 and #18 engaged in conversation. Number 13 and others became louder and disturbing to some. Most Ss asleep.

0400-0800 Very quiet at 0400. At 0630 shelterees sat up. Some conversation about food and coffee. CONELRAD evoked laughter. At 0700 food and water were distributed. At 0730 Post-Shelter Questionnaire was administered.

0800-end Medic left first at 0845. The other shelterees then left in twos and threes every few minutes. There was high excitement and humor. Last shelteree exited at 1010.

3. Defections

A total of eight shelterees left the shelter before the scheduled exit. An outline of departure times, shelterees exiting, and complaints is presented in Table 3.

The first shelterees to leave (#30 and #6) made their exit at approximately 0930 after their first night in the shelter. Shelteree #30 (male, age 50) complained of being very sore from sleeping on the concrete floor, of having a bad headache, and of not having had a bowel movement in two days. The exit medical exam stated that arthritic complaints were compatible with bursitis of the shoulder. This shelteree did not voice any complaint of food, water, space, or any individuals in the shelter. Shelteree #6 (male, age 18) complained that he "couldn't stand being cooped up in one room," and that he had a headache since the day before. He did not mind sleeping on the floor, the food, the water, or persons in the shelter. He did complain that the shelter was too crowded.

At 1530 on Saturday after approximately twenty-four hours in the shelter, shelterees #29, #25, #26 and #4 made their exit. Shelteree #29 (female, age 47) complained of general aches from sleeping on the hard floor and of dizziness. Shelteree #25 was the first to complain of odors. She referred to body odors as well as odors from the commode room. Complaints were also directed at the lack of bedding and resulting

Table 3

Exit Times and Complaints of Early Exit Shelterees
in Experimental Study I

Date	Time	Shelteree Number	Age	Sex	Complaint
Sat. Dec. 15	0930	#30	50	M	Bones ache, Constipation, Headache
	"	#6	18	M	Headache, Claustrophobia
	1530	#29	47	F	Aches, Dizziness
	"	#25	45	F	Odor and hard floor
	"	#26	49	M	Boyfriend of #25 who requested that he leave with her
	"	#4	19	M	Angry because someone at employment office had misrepresented the conditions. Did not feel accepted by group. Wanted to smoke.
	1657	#3	16	F	Couldn't eat, claustrophic reaction
Sun. Dec. 16	1707	#17	35	F	Mild hysterics (crying, nausea, shortness of breath)

soreness. Shelteree #26 (male, age 49) left the shelter with #25 at her request. He stated that he would otherwise have remained. Number 4 (male, age 19) complained of noise, boredom, lack of ventilation, and lack of cigarettes. He did not feel obligated to stay, since he felt that someone had not adequately represented the conditions: he had expected a pool table and other comforts.

An hour and a half later, #3 (female, age 16) made her exit complaining of inability to eat the Bulgur wafer. She had not eaten since entry. She complained that the taste of the water was worse than the food. Since childhood she had always been frightened of being locked up in a small room. Her desire to leave became intensified when she saw four people leave an hour previously. She also stated that she never used the chemical commode.

Twenty-four hours later #17 (female, age 35) left the shelter and was diagnosed as suffering a mild hysterical reaction. She complained of headache, shortness of breath, nausea and tightness of the throat. She was crying upon exit. This shelteree had no specific complaints about odors, food, or water. She said she "enjoyed" the food and could have lived a month on this diet. Her most specific complaint was that the shelter was too crowded.

No further shelterees made early exits and all remaining were in apparently good health and spirits on Tuesday morning when the four-day occupancy test was concluded.

4. Shelteree Reactions

Three questionnaire-type instruments were used in assessing shelteree reactions: (1) a Shelter Entrance Questionnaire completed prior to entrance into the shelter; (2) an unstructured Shelter Diary sheet completed by each shelteree on the morning and evening of each confinement day; and (3) a longer Post-Shelter Questionnaire completed by each shelteree just prior to his emergence from the shelter.

a. Questionnaires

The pre-shelter questionnaire sought to determine shelteree reasons for choosing to participate in the study, their awareness as a representative group of civil defense propaganda, and their ideas of what the shelter experience will consist.

The shelter diary provided occasion for each shelteree to express in an unstructured manner what he felt, thought, and experienced, and his impressions of fallout-shelter living.

The post-shelter questionnaire consisted of a rank-ordering by the shelterees of what they liked and disliked about the study, why they felt as they did about these likes and dislikes, an evaluation of one's own and others' difficulty in coping with shelter living, and a series of sociometric choices. Shelteree reactions to the four-day experimental study, though gained by means of a somewhat different approach than that utilized in the pilot studies, was comparable to the pilot study findings reported in the Sept. - Dec., 1962, Quarterly Report.

Pre-shelter questionnaire data suggest that the group was largely uninformed concerning specific aspects of the study, though they did manifest a good general grasp of the situation, and were largely unactivated with regard to being prepared for survival in a nuclear emergency. More than half did not know of a community shelter where they could take cover, and even larger proportions were unprepared in other ways. Greatest discomfort was anticipated concerning sleep conditions, lack of bathing facilities, food and boredom.

Shelter diary information focused major complaint on the hardness of the floor, lack of space, and food. Positive remarks most often concerned shelter inhabitants and social activity. Diaries are discussed in another section of this report.

Post-shelter questionnaire data revealed sleep conditions as the most dominant disliked factor, followed by discomfort with food, lack of space, the chemical toilet, and the lack of water. According to shelteree rankings of contributing

factors to discomfort with sleep conditions, the hardness of the floor is unanimously given as the major reason, and is followed by the closeness of other people (a space problem), lack of pillows and blankets, and coldness of the floor. Food appeared to be a discomfort primarily because the allotted amount did not satisfy appetites and lacked variety. Too, the Bulgur wafer seemed to cause thirst which was not quenched by one quart of water per day. Discomfort incurred by the chemical toilet seemed accented by a bad odor which was not concealed by the chemical solution provided. The drinking water was a discomfort primarily because there was not enough of it, particularly for the male shelterees; some shelterees also reported that it tasted bad.

Upon being asked to estimate how much longer than four days they could remain in the shelter, the shelterees said about two more days. The average male estimate was about three additional days, whereas the females averaged only one additional day in their estimate. Some 36% said they would not have volunteered for the study if they had known what it would be like, and 63% said they would not volunteer to stay in the shelter again. Seventy-seven per cent of the shelterees felt that living in the shelter was a difficult task. Major suggestions concerning items the shelterees felt should be added to such a shelter included bedding, better food, recreational materials, and more than 1 quart of water/person/day. The factor which the shelterees ranked as a primary like about the study was the opportunity to test their own endurance. Other than this, rankings of favorable aspects of the study tended to be randomized to the point of obscuring any significant insight.

By and large, the questionnaire findings for the four-day Experimental Study I disclose a shelter group which was uncomfortable with its confinement to the point of probably defecting had the study lasted longer. Added to this observation is the fact that 27% of the group defected fore the conclusion of the study.

b. Shelter Diaries

The purpose of the shelter diary forms, administered at 9 A.M. and 9 P.M. daily, was to obtain a subjective running account of shelterees' opinions of different aspects of shelter confinement.

In the four-day study, the majority of shelterees expressed themselves freely in two, three, or four paragraphs, while others wrote only short sentences. Comments varied on a continuum from direct expressions such as, "the floor is too hard and cold," and "I don't like the shelter -- that is why I am leaving," to elaborate opinions about the advisability of austere shelter studies or living.

In the analysis of diary material, a complaint by at least 50% of the shelterees was assumed to be significant. Two such complaints emerged on various days: "cool temperature," and "sleep conditions." The cool temperature was complained of after the first night in the shelter, presumably due to draft under movable wall, and subsequent correction removed this complaint thereafter. Sleep conditions reached the 50% complaint level on the morning of the third day. Two complaints which did not reach the 50% level at any given time but which were consistent throughout the study were "hardness of floor," and "lack of space."

c. Shelter Manager Report

The suggestions and criticisms contained in the report provide variables for evaluation in longer confinement studies.

5. Observational Data

The structured "observer form" was used by the third observer to record position and activity counts every quarter of the hour. The purpose

of these activity and position counts was to measure group change occurring over the four-day confinement period.

Careful examination of the completed forms indicated that the bodily positions, sleeping, and discussion categories be analyzed further. The principal reason for this decision was based upon the meager number of observations in the excluded categories.

The mean observation frequency for each hour of each category was obtained and divided by the number of shelterees in the shelter at that time. This yielded a frequency percentage independent of early exits, and therefore not disturbed by these exits. (See Figures 1, 2, 3, 4, and 5.)

Figures 1, 2, and 3 reveal only slight daily changes in bodily position over the four-day occupancy. The daily sequence of bodily position appears altered with continuing stay in the following ways:

(a) There appears to be a successive decline in frequency of shelterees observed in the standing position.

(b) Frequency of observation of shelterees in the sitting position appears to increase with each successive day.

(c) There appears to be little if any change in the number of shelterees observed in the lying position with increasing amount of time in the shelter.

Figure 4 reveals only slight changes in daily pattern of sleep by the group.

Figure 5 depicts daily cycles of group conversation. Peak verbal socializing appears to occur between 6 and 9 P.M. Lesser peaks occurred between 8 and 10 A.M., and 12 and 2 P.M.

The utility of this observational approach appears to have been verified by the obtained data. The figures provide an overall perspective of the shelter occupancy

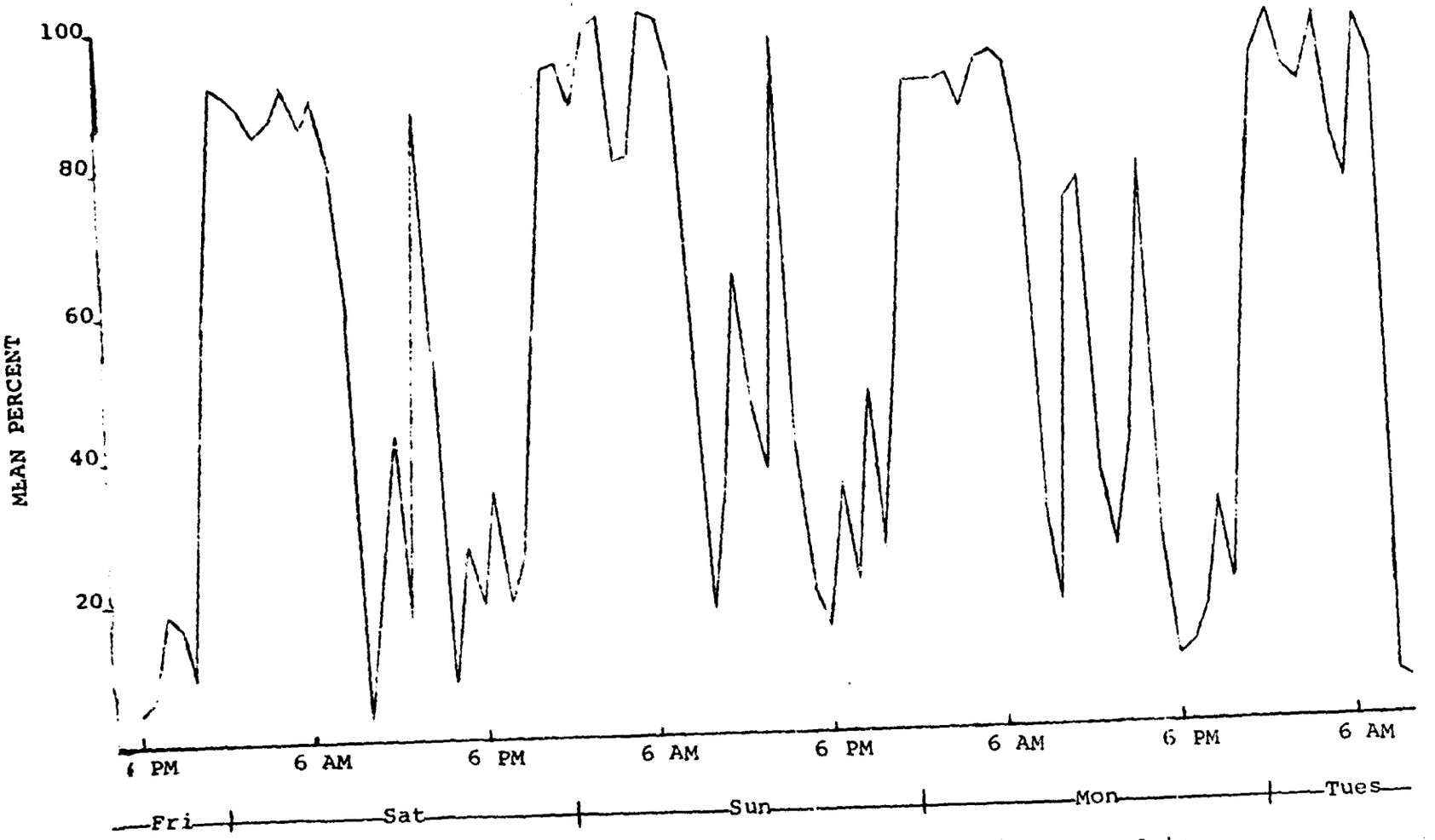

Fig. 1 Hourly Change in Percentage of Shelterees Observed in the Lying Position (Experimental Study I, four-day confinement)

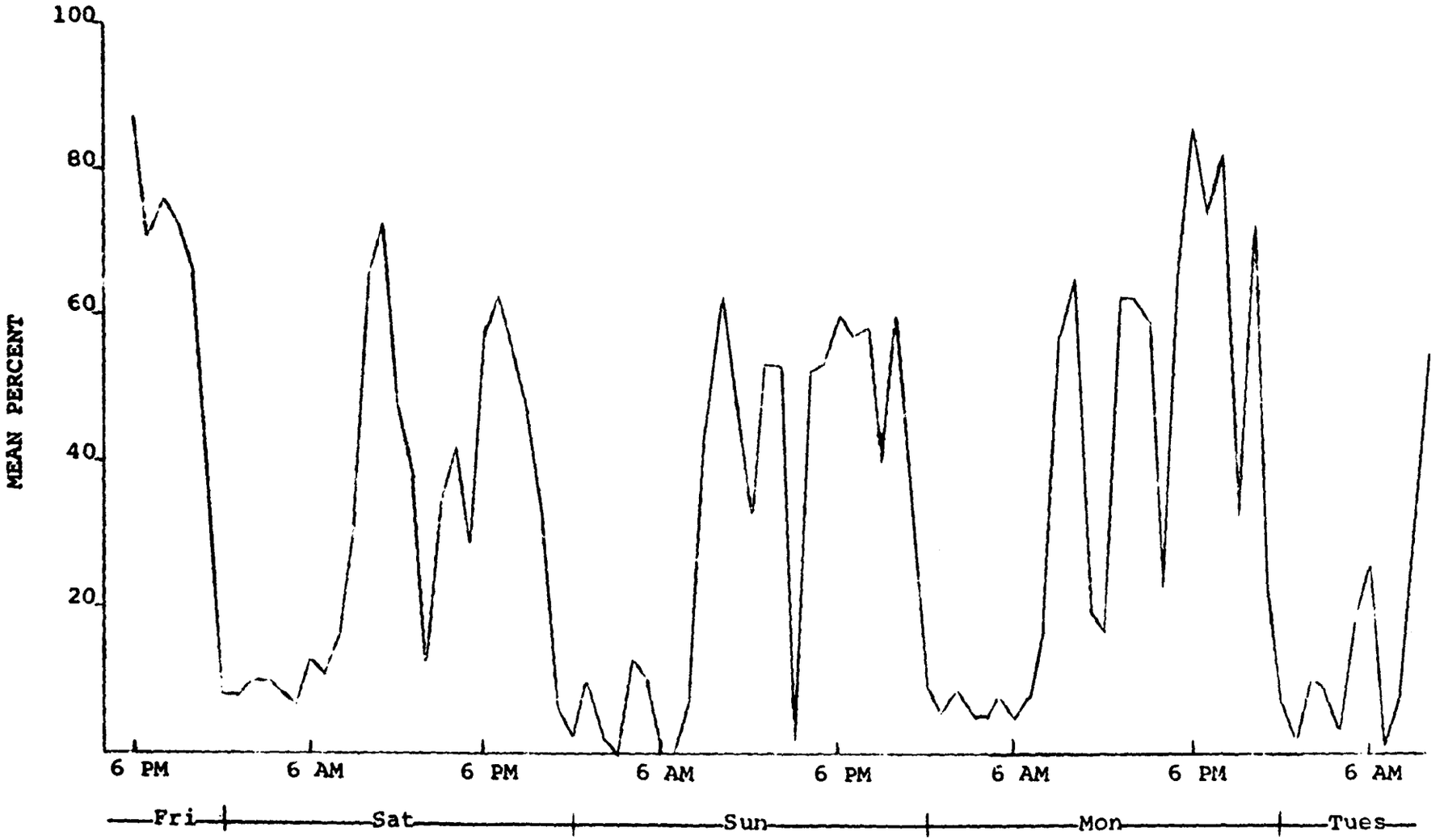

Fig. 2 Hourly Change in Percentage of Shelterees Observed in the Sitting Position (Experimental Study I, four-day confinement)

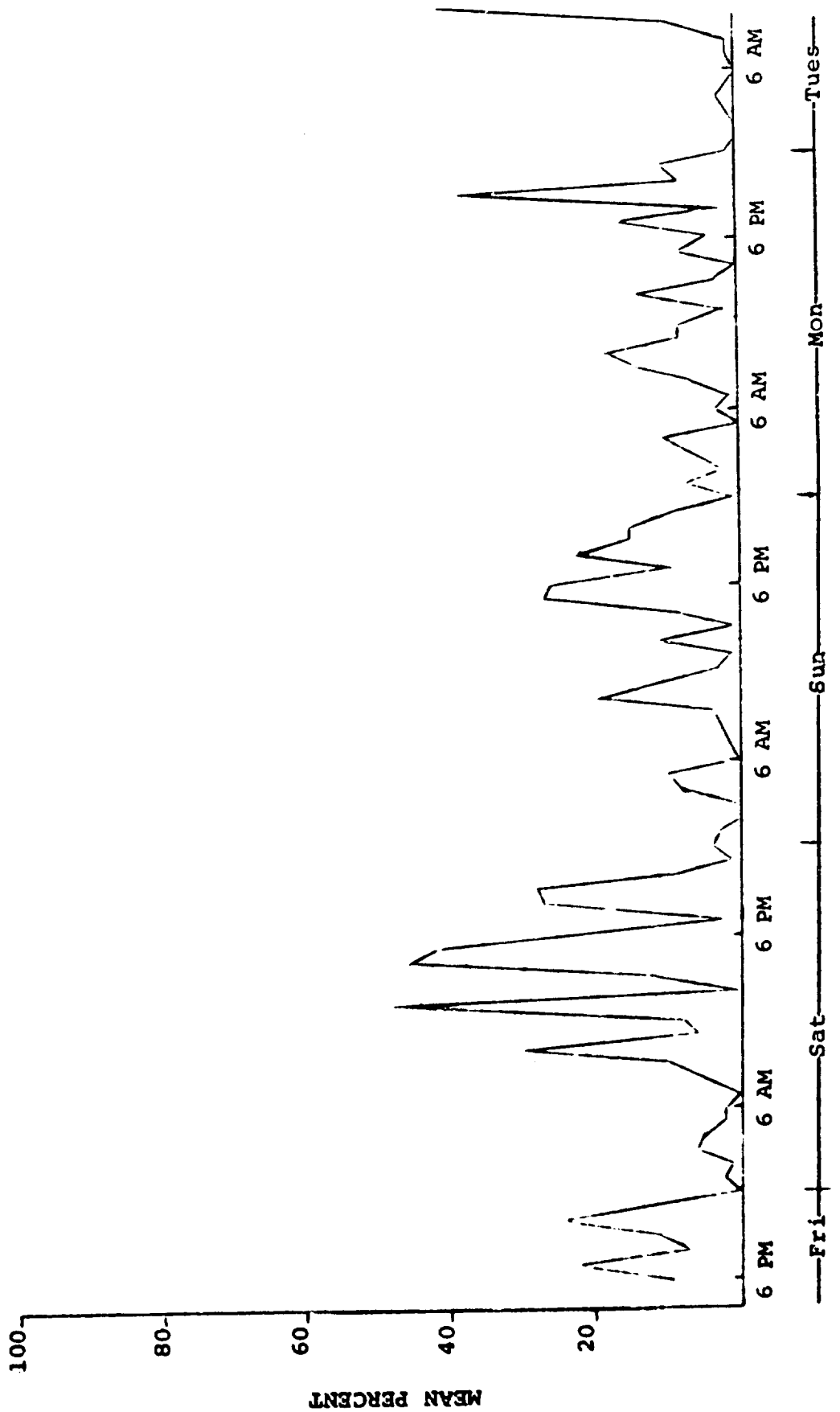

Fig. 3 Hourly Change in Percentage of Shelterees Observed in the Standing Position (Experimental Study I, four-day confinement)

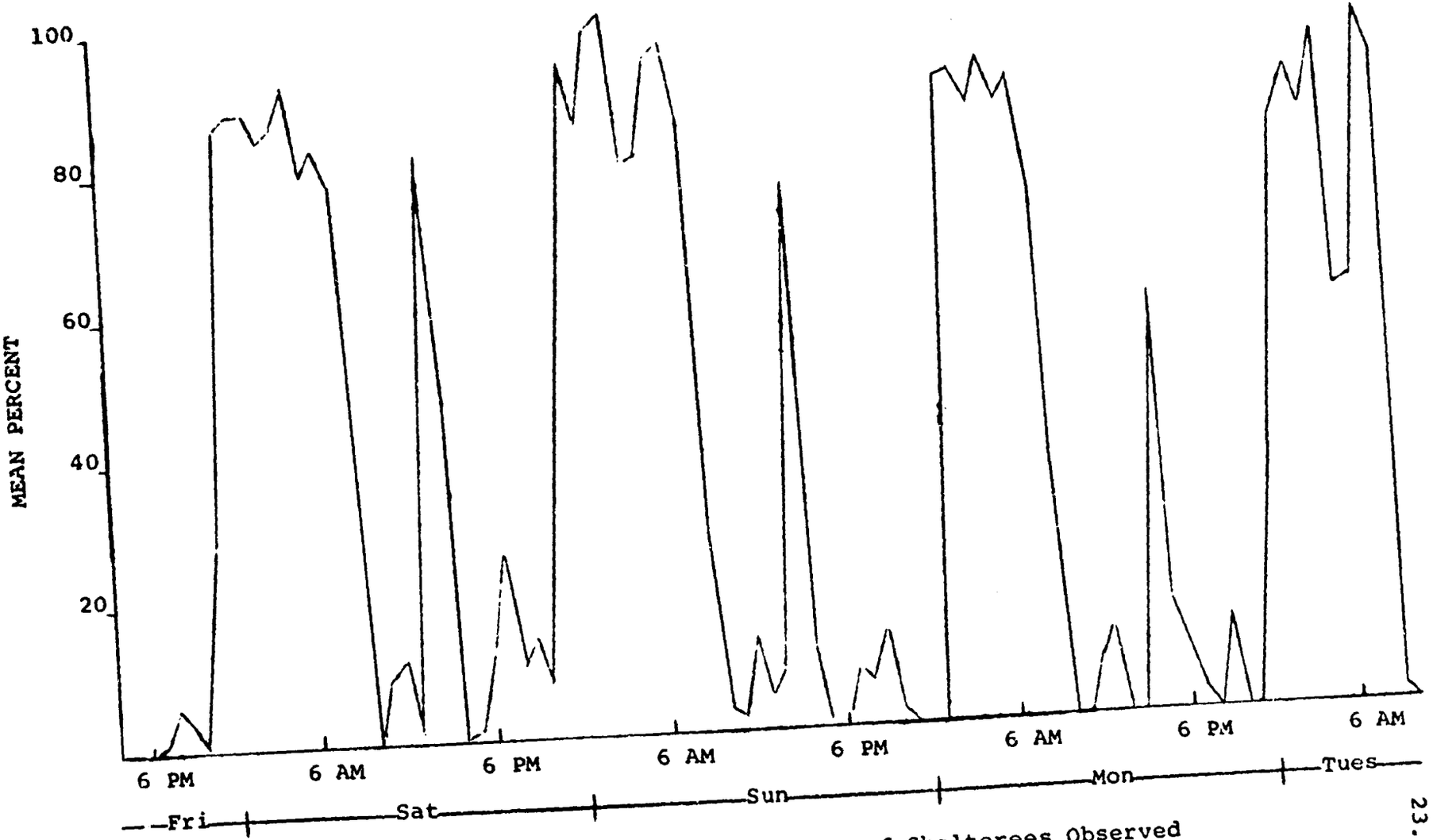

Fig. 4 Hourly Change in Percentage of Shelterees Observed Sleeping (Experimental Study I, four-day confinement)

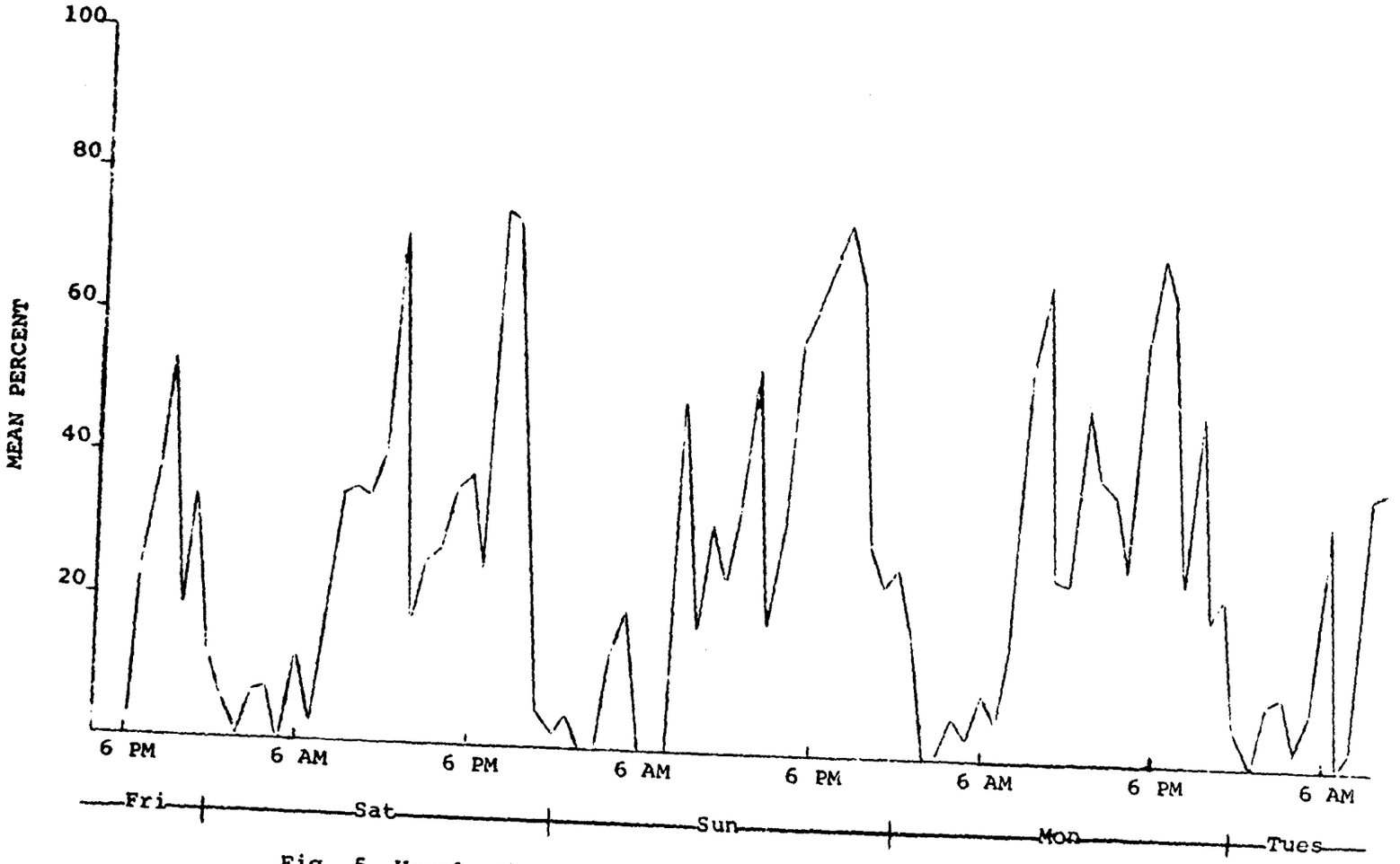

Fig. 5 Hourly Change in Percentage of Shelterees Observed in Conversation (Experimental Study I, four-day confinement)

with reference to a number of behavioral categories. It remains to be seen whether more significant changes occur with longer shelter continement studies.

6. Environmental Data

a. Temperature and Humidity

The conditions of temperature and humidity were designed so as to remain within a "comfortable" range for the shelterees. Based upon information obtained from prior studies, the initial temperature setting was 83° dry bulb, with a relative humidity greater than 50%. This combination of conditions produced an effective temperature of 76°. However, upon entry and during the subsequent few hours, the temperature was elevated in compliance with the wishes of the shelterees. The dry bulb temperature was set at 87° $\pm$ 2°, producing an E.T. of 79° $\pm$ 2°. This temperature proved to be acceptable to the shelterees, although for some it was extreme during some phase of activity within the shelter (e.g., cool for sleeping or hot for waking hours). The mean room E.T. over the four days ranged from 79° - 83°.

b. General Activity Level

The levels of general bodily activity for the four-day confinement period are presented in Figure 6. As is seen in Figure 6, the circadian patterning of activity is clearly shown. When this figure is compared with sitting, standing, and lying observational data (Figure 1 - 5), there is a high correlative trend. It is to be noted that there was an apparent decrease in activity after the first 24-hour period. This may have been due to the departure of seven shelterees.

c. Noise Level

Figure 7 presents the data on noise level changes during the confinement period. The data are presented in terms of millivolts and are intended to show relative changes in noise level, rather than absolute values. When Figures 6 and 7 are compared,

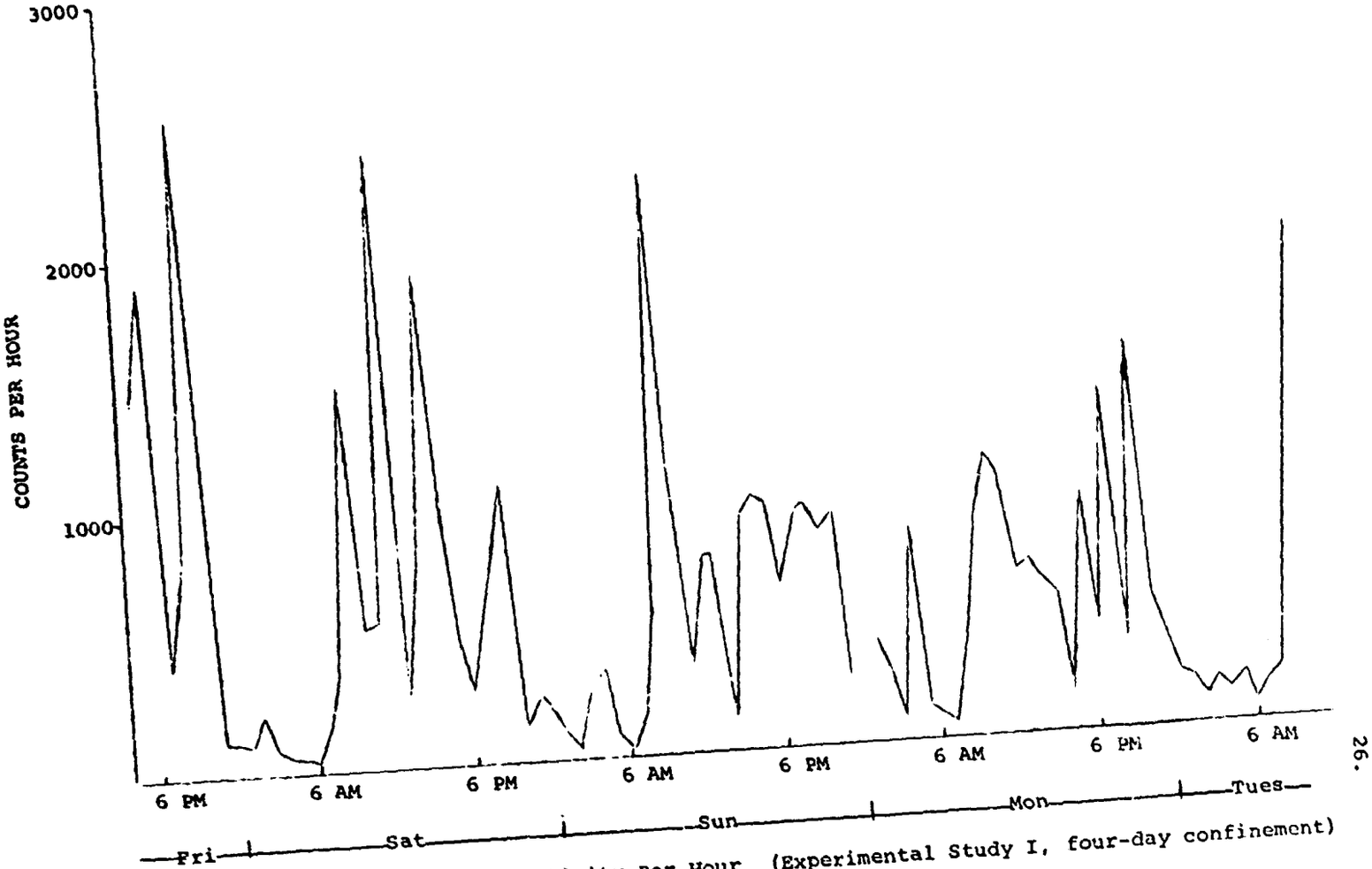

Fig. 6 The General Level of Activity Per Hour (Experimental Study I, four-day confinement)

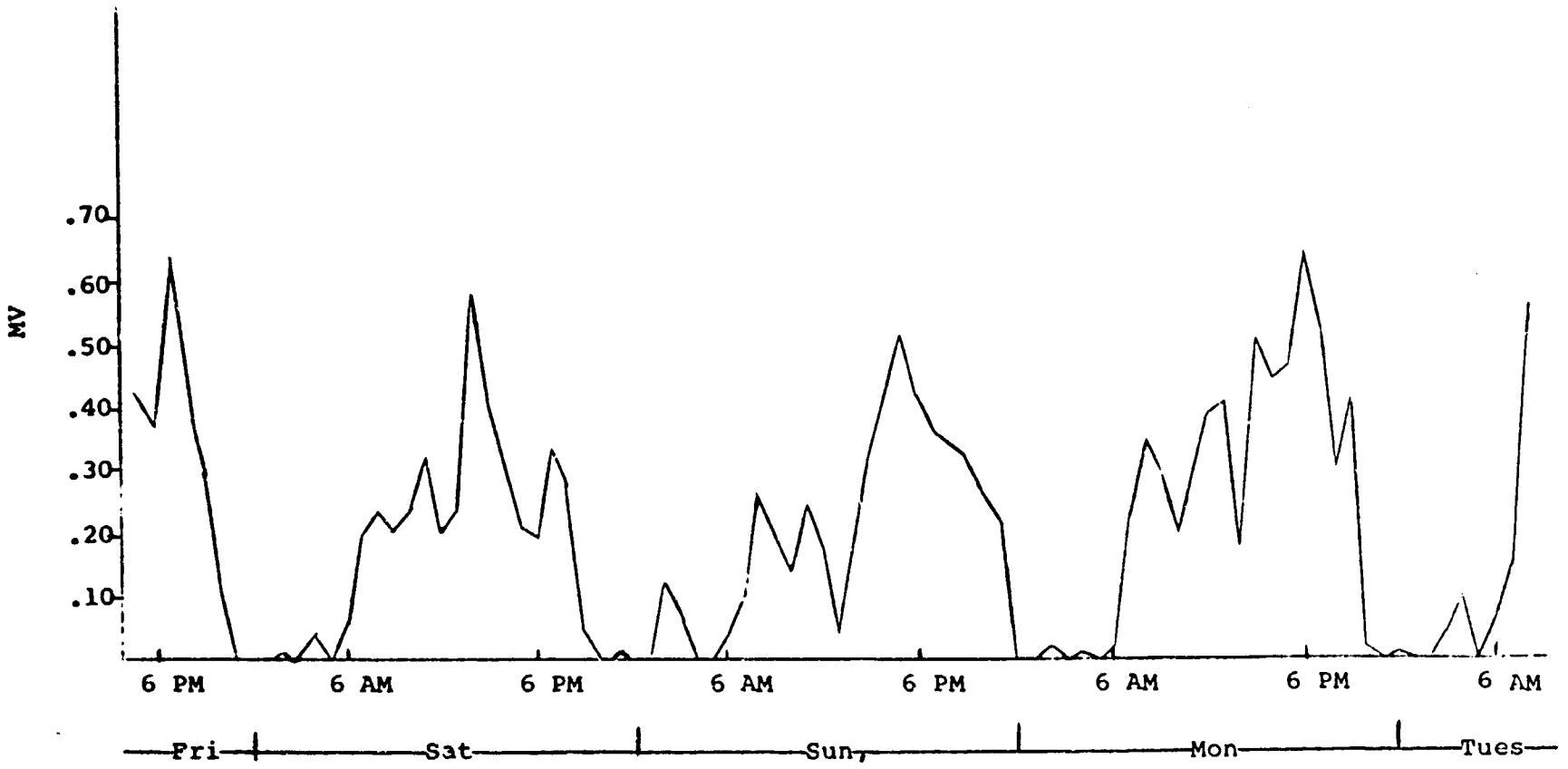

Fig. 7 The Relative Changes in Noise Level Within the Shelter
(Experimental Study I, four-day confinement)

it is noted (as would be expected) that when the shelterees were most active, they were also noisier. In contrast to the indications of Figure 6, Figure 7 indicates that the level of noise remained approximately the same over the four-day period, even though almost one-fourth, or seven, of the people had departed the shelter at the end of 28 hours. This indicates that the remaining shelterees became noisier as a function of time in confinement. These measures are supported by direct observation.

d. Lighting Changes

Figure 8 presents the measured values of illumination. In addition to the variable lighting, there was a constant lighting supplied from a 10-watt bulb in the latrine, and a 7.5-watt bulb used to produce a slight glare on the shelter side of the large observation window. Although these data do not reveal any unexpected significant changes over the study period, they do demonstrate the capacity for detecting pattern changes in future studies of longer duration.

B. Pre- and Post-Shelter Test Results

1. Medical Examinations

Medical diagnoses of the eight shelterees who left during the study have been discussed under "Defections." For the 22 individuals who completed the study, there were no significant changes from the pre-shelter to the post-shelter medical examination, other than an average weight loss of 6.5 pounds.

2. Physical Fitness Testing

On the physical fitness battery, there were consistent losses on all measures. Only the loss of weight, however, proved to be statistically significant, and shelterees returned to their normal weight within one week.

The Harvard Step Test was originally selected as an index of cardio-vascular condition. However, it appeared that the shelterees' lack of motivation in taking this test, which involves strenuous effort,

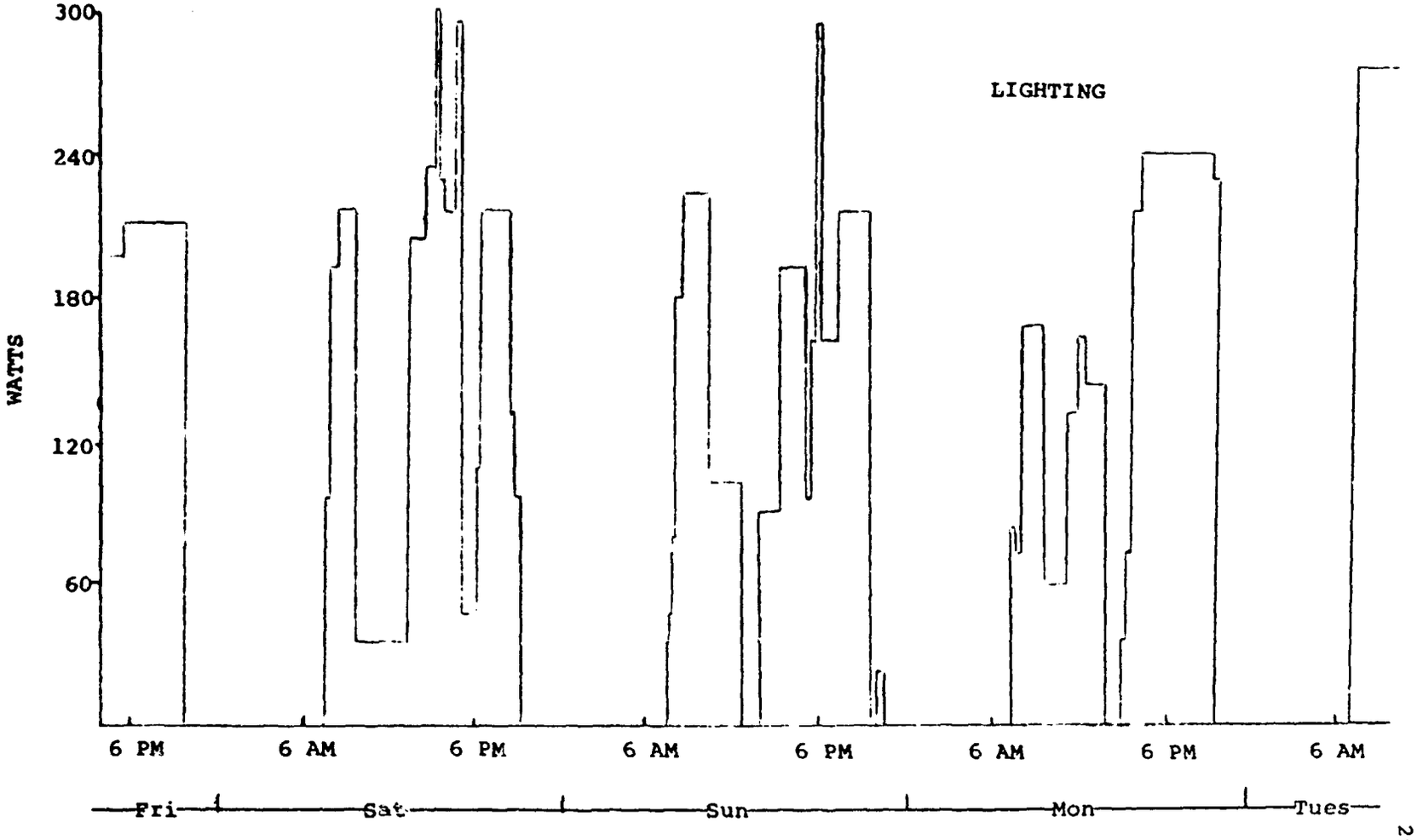

Fig. 8 The Continuous Lighting Recordings (Experimental Study I, four-day confinement)

obscured any meaningful interpretation of changes.

3. Psychological Testing

Because of the physical and psychological stresses of confinement, some depreciation of mental test factors was hypothesized. However, no significant depreciation occurred. With one exception, mean scores on each measure increased from pre-test to post-test for males and females. The increases may be due to practice effect, although alternate forms of each test were used for post-testing.

The MMPI and SORT scores were well within the normal range. One of the MMPI scales characterized the group as having a general disregard for social customs and mores. There were no significant changes in personality patterns for the women. On two of the ten MMPI scales, however, significant changes from pre- to post-confinement were noted for the men. These scales indicate that male shelterees exhibited mild symptoms of depression, excessive worry, lack of self-confidence, and difficulty in concentration as a consequence of shelter confinement.

IV. Conclusions

The following conclusions are indicated by this study:

1. Stress variables were severe; 27% (eight of thirty) shelterees defected during the study.

2. Remaining shelterees predicted they could endure two more days of confinement before feeling compelled to leave.

3. Primary complaints were hardness of floor, lack of space, food, and chemical toilet.

4. Shelterees completing the study were in relatively good physical, mental, and psychological condition.

5. There appeared to be a general lack of observance of high standards of social mores and customs.

6. The volunteers serving as shelterees in this study were inadequately informed on Civil Defense matters and inadequately prepared for any nuclear emergency.

7. Behavioral and environmental findings in this study will be further evaluated in future studies of longer confinement.

V. Forecast

Experimental Study II, a two-week occupancy study, was conducted 16 February - 1 March, 1963, and analysis is in process. For this reason, Experimental Study II is included under the "Forecast" of this report. Findings will be presented in detail in the April - June, 1963, Quarterly Report. The variables involved in Experimental Study II are listed in Table 4.

Table 4

Variables Evaluated in Experimental Study II
(16 Feb. - 1 Mar., 1963)

Shelteree Characteristics

Number--Thirty (30), including a trained shelter manager and a medic
Age--7 to 70 (contingent on medical approval)
Sex--15 males, 15 females

Shelter Environment

Space--8 sq. ft./person (52 cu. ft./person)
--1 cu. ft./person storage additional
Temperature--optimal
Humidity--optimal
Ventilation--15 cfm/person (3 cfm fresh air, 12 cfm recirculated air)

Shelter Supplies

Water--2 qts./person/day
Food--900 cal./person/day (Bulgur Wafer)
Sanitation- Sanitation Kit III
Medication--Medical Kit A
Radiological Kit
Bunks--none; will sleep on corrugated cardboard placed on concrete floor
Blankets--none
Recreational materials--none
Washing water--none
Coffee--none
Cigarettes--smokers will be permitted to bring one pack of cigarettes for the shelter stay

Appendix D

Experimental Study II

Table of Contents

Abstract

From 16 February - 1 March, 1963, the University of Georgia Psychological Laboratories conducted a two-week simulated fallout shelter occupancy study surpassing all previous shelter research in austerity.

Thirty shelterees, 15 males, 15 females, aged 9-67, participated in the experiment. Stress conditions included restricted food and water rations, minimal living space (8 sq. ft./person), a chemical toilet, reduced ventilation, and sleeping on thin cardboard placed over a concrete floor. There were no bunks, no blankets, no recreational supplies, no water for bathing, no coffee, and only one pack of cigarettes permitted per smoker.

Water intake averaged 1.5 qt./person/day and food consumption averaged 789 cal./person/day. Five defections occurred during the study. The remaining shelterees emerged in good physiological and psychological condition.

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I. Introduction

Results of a series of simulated fallout shelter occupancy studies being conducted at the University of Georgia Psychological Laboratories were presented at an Office of Civil Defense Research Seminar held at the Pentagon on 13 March, 1963. Earlier investigations of this research program have been described in previous quarterly reports. The present report gives an account of Experimental Study II, a two-week occupancy study implemented 16 February - 1 March, 1963.

Assistant Secretary of Defense Steuart L. Pittman paid a personal visit to the Psychological Laboratories during the study and wrote a message for the shelterees. Mr. Pittman was accompanied by Mr. Walmar Strope, Director of Research for OCD, Mr. Fred Carr, Project Coordinator, and aides.

II. Experimental Design

A. Purpose

Experimental Study II was a two-week study designed to test the conditions listed in Table 1. These conditions surpass all previous shelter research in austerity. Comparisons between Experimental Study II and other shelter occupancy research are presented in Table 2.

B. Experimental Variables

Space allowed per person was 8 sq. ft. and 52 cu. ft., with 1 cu. ft. for storage. Temperature and humidity were optimal. Water ration was 2 qts./person/day (10.7 six-ounce cups/person; 12 water drums in shelter). Food ration was 1,000 cal./person/day (12 Bulgur wafers @ 89 cal.). Sanitation Kit III (25 persons) was used and Medical Kit A (50-65 persons, 14 days). A radiological kit completed the OCD supplies. There were no bunks or blankets. Shelterees slept on a concrete floor and were provided only with a corrugated cardboard measuring 5' x 2' x 3/16" thick, for a mat. There were no recreational supplies, washing water, or coffee provided. Smokers were permitted to bring in with them one package of cigarettes, or 1 3/8 ounces smoking tobacco with pipe, or five cigars.

Table 1

Variables Evaluated in Experimental Study II
(16 February - 1 March, 1963)

Shelteree Characteristics

Number - Thirty (30), including a trained shelter manager and a medic
Age - 9 to 67
Sex - 15 males, 15 females

Shelter Environment

Space - 8 sq. ft./person (52 cu. ft./person)
- 1 cu. ft./person storage additional
Temperature - optimal at 79° ET
Humidity - optimal at 50%
Ventilation - 15 cfm/person (3 cfm fresh air, 12 cfm recirculated air) first day; changed to 40 cfm/person (8 cfm fresh air) from second day to completion.

Shelter Supplies

Water 1½ qts./person/day consumed out of 2 qts./person/day provided
Food - 789 cal./person/day (Bulgur wafer) consumed out of 1,000 cal./person/day provided
Sanitation - Sanitation Kit III
Medication - Medical Kit A
Radiological Kit
Bunks - none; slept on 3/16-inch corrugated cardboard placed on concrete floor
Blankets - none
Recreational materials - none
Washing water - none
Coffee - none
Cigarettes - smokers permitted to bring one pack of cigarettes for the shelter stay

TABLE 2

Two-Week Shelter Occupancy Studies Conducted in the United States

Study	Date	Shelterees			Shelter Environment					Shelter Supplies								
					Space/person					Water	Food							
		N	Sex	Age	sq.ft.	cu. ft.	Temp.	Hum.	Ventilation cfm/person	qt./person/day	cal./person/day	Sanitation	Bunks	Blankets	Bath Water	Coffee	Cig.	Recreat. Supplies
University of Georgia Psychological Laboratories Experimental Study II	Feb. 1963	30	Men, women, children	9-67	8	54	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)	1.5	789 cal. Bulgur wafer	chemical toilet	No	No	No	No	1 pk.	No
Bureau of Yards and Docks; Naval Research Laboratory; Naval Medical Research Institute	Feb. 1962	100	Men	17-24	12	117	opt.	opt.	3 - 5	1.8	1617 cal. crackers w/adjuncts	chemical toilet	Yes	Yes	Yes	Yes	Yes	Yes
American Institute of Research	June 1960	30	Men, women, children	7-72	8	58	warm	warm	15 (30% fresh air)	4.2	2000 cal. various foods	flush toilet	Yes	Yes	No	Yes	Yes	Yes
U. S. Naval Radiological Defense Laboratory	Dec. 1959	100	Men	17-62	12	117	opt.	opt.	2.6 - 5(100% fresh air)	1.9	2000 cal. various diets	chemical toilet	Yes	No	No	Yes	Yes	Yes
Princeton Study (Jack A. Vernon's "Project Hideaway")	1959	5	Men, woman, and 3 children	2 yrs.- adult	14.4	115	opt.	opt.	(?)	2	3000+ cal. (?)	chemical toilet	Yes	Yes	Yes	Yes	Yes	Yes

Children were permitted to bring textbooks, since their schooling was to be continued during the two weeks' occupancy period. Personal items permitted all shelterees consisted of clothes worn plus one change of underwear and socks or stockings; toilet articles (toothbrush, toothpaste, mouthwash, handbag cosmetics); one package of cigarettes, or five cigars, or one package of pipe tobacco. Items excluded were food, candy, soap, shaving gear, eating or cooking utensils, and pillows or blankets.

C. Shelterees

The shelterees were drawn at random from a pool of 867 applications which had been stratified by age and sex. There were 15 males and 15 females. The youngest boy was 9, the youngest girl was 10; the oldest man was 61 and the oldest woman 67. There were 7 children between the ages of 9-13 years, 16 adults in the range of 16-46 years, and 7 older adults between 50-67 years. The mean educational level for the adults was 10.5 years (see Table 3).

Most of the adult females were housewives. Of those who were gainfully employed , one was a cook, one a textile weaver, and the other a welfare worker. For the men the range of occupations covered such work as farming, construction, sales, and law. The shelter manager, a law student 23 years of age, was specifically selected and trained for this assignment. The shelter medic, 28 years of age, was a volunteer from the Medical College of Georgia at Augusta.

D. Pre- and Post-Shelter Testing Procedures

Pre- and post-shelter testing for Experimental Study II consisted of a medical examination, a physical fitness battery, and psychological evaluation.

Table 3

Educational and Occupational Characteristics of Shelterees in Experimental Study II

Sex	Age	Education	Occupation
M	9	3	Student
F	10	4	Student
F	10*	4	Student
M	11	5	Student
M	11*	5	Student
M	11	5	Student
F	12*	7	Student
F	13*	7	Student
F	16	10	Student
M	16	10	Student
F	21	7	Housewife
M	23	A.B. & L.L.B.	Law Student
M	28	Senior Medical	Medical Student
M	34	12	Farmer
M	36	3½ yrs. college	Unemployed salesman
F	37	College grad.	Child welfare worker, mother
F	38	12	Housewife, mother
F	39	High School Grad.	Textile Operator
M	39*	10	Unemployed
F	41	High School Grad.	Homemaker, mother
M	43	3	Unemployed truck driver
M	45	3	Unemployed farmer
F	46	High School Grad.	Housewife, mother
F	50	6	School lunch-room cook
M	53	2 yrs. college	Unemployed office worker
M	59	10	Carpenter
F	60	8	Housekeeper, mother
M	61	12	Salesman
F	62	10	Retired church secy.
F	67	5	Farmer's wife

*Defected during the study

1. Medical Examination

In addition to an initial screening medical examination by the family doctor, each subject was examined just prior to shelter entry by a consulting physician. This final examination involved a check of the shelteree's heart, lungs, temperature, pulse rate, blood pressure, and respiratory tract. Blood and urine analyses were also performed.

2. Physical Fitness Testing

The Rogers Strength Test was utilized for the physical fitness battery, and includes seven items: lung capacity, strength of right and left grip, back lift, leg lift, push-ups, and pull-ups. The strength index is the gross score obtained from adding these items, after pull-ups and push-ups have been combined in a formula to provide an arm strength score.

Measurement of the individual's eye-hand coordination was accomplished in two ways: (1) by the use of the pursuit rotor, and (2) by use of the coordination test of the Flanagan Aptitude Classification Test battery (FACT).

The pursuit rotor is a revolving disk such as a phonograph turntable having a metal spot on its surface near the outer edge. The subject attempts to keep an electric stylus attached to a timer in contact with the spot as the disk rotates.

The coordination test of the FACT battery is designed to measure the ability to coordinate hand and arm movements. It involves the ability to control movements in a smooth and accurate manner when these movements must be continually guided and readjusted.

3. Psychological Test Battery

The School and College Ability Test (SCAT) and sections of the General Aptitude Test Battery (GATB) were used for the appraisal of intellectual functioning. The SCAT, a measure of school-learned abilities, includes reading skill and handling of quantitative information.

The "Verbal" part involves comprehending the "sense" of a sentence and attaching meaning to isolated words. The "Quantitative" sections require manipulation of numbers and solving of quantitative problems.

The verbal, numerical and spatial aptitude sections of the GATB were administered to the adult members of the group.

The Minnesota Multiphasic Personality Test (MMPI) and the Structured Objective Rorschach Test (SORT), described in previous quarterly reports, were again used in assessing personality characteristics.

4. Pre-Shelter Questionnaire

A Shelter Entrance Questionnaire was given prior to shelter entrance to obtain information on reasons for shelter participation, expectancies of shelter life, and family preparedness for a nuclear emergency.

E. Behavioral and Environmental Measures

1. Observers and Observational Forms

Two-man observer teams stood four-hour watches around the clock. One observer monitored the instrumentation, while the other kept a continuous log of shelter events. Detailed duties of the observer teams have been presented in previous quarterly reports.

2. Environmental Measures

Environmental measures included temperature changes, humidity variations, general activity levels, noise levels, and lighting variations.

Films were taken of shelter activities, to be incorporated later in a 29-minute 16 mm black and white documentary film of the series of occupancy studies being

conducted at the University of Georgia.

The present contract was amended in March, 1963, providing additional funds for this purpose.

3. Nutritional Analysis

For purposes of evaluating the nutritional adequacy of the resultant 789 -calories/person/day consumption of the Bulgur wafer, and the 1½ qts./person/day water consumption, an exhaustive blood and urine testing procedure was carried out. Dr. Paul L. Piercy, Head, Department of Physiology and Pharmacology, University of Georgia School of Veterinary Medicine, and Dr. H. C. Morgan, Assistant Professor of Veterinary Medicine, supervised the collection and analyses of blood and urine samples. In addition, the U. S. Army Medical Research and Nutrition Laboratory, Fitzsimmons General Hospital, Denver, Colorado, performed analyses requiring specialized laboratory equipment.

Blood samples were taken twice, the first time in the morning following the first night in the shelter and again at the termination of the study. Twenty-four-hour urine samples were collected four times during the two-week confinement period. An outline of the blood and urine tests is given in Table 4.

F. In-Shelter Program

1. Shelter Manager Training

Prospective shelter managers were interviewed and given a questionnaire to complete. The manager selected for this study was a 23-year old recent graduate of the University of Georgia Law School. He received approximately twenty-three hours of training devoted to familiarization with shelter equipment and supplies, experimental design of the shelter test, and instruction in general Civil Defense information. A detailed outline of shelter manager training has been included in previous quarterly reports. The shelter

Table 4

Nutritional Analysis in Experimental Study II

	USA Med. Res. & Nutrit. Lab Fitzsimmons Gen. Hosp. Denver, Col.	School of Veterinary Medicine U. of Georgia
Blood Tests (prior to entry and upon exit)	Riboflavin (Vit. B_2)	Hemoglobin
	Erythrocyte transketolase	Hematocrit
		Mean corpuscular hemoglobin concentration
		Plasma protein
		A/G ration
		Electrolytes (sodium potassium, calcium, bicarbonates)
		Vit. A
		Vit. C
		Carotenoids
Urine Tests (four 24-hour samples)	Thiamin (Vit. B_1)	Non-protein Nitrogen (N P N)
	Riboflavin (Vit. B_2)	
	Vit. B_6	
	N'Methylnicotinamide	
	Niacin (Vit. B complex)	

manager wrote a personal report of duties expected of him during his shelter stay.

2. Activity Program

As in Experimental Study I, an informal program of in-shelter activities was followed, without adhering to a rigid time sequence. Training periods were to occur at appropriate times when the greatest number might benefit. Organized lectures and recreational activities were to be implemented at the discretion of the shelter manager, acting on the basis of a democratic process.

A facet of the daily program was the completion of diary forms twice daily by the shelterees, who were encouraged to write their thoughts, feelings, and personal experiences. These forms were collected in the morning and evening and passed out of the shelter.

G. Schedule of Events

Shelterees were to arrive at the Psychological Laboratories at 8:30 a.m. on 16 February. They were received by staff members and given a brief orientation on the day's proceedings. Medical examinations were first given, followed by physical fitness testing and psychological testing. All tests were completed by late afternoon. Prior to entering the shelter, the group was addressed by the Project Directors, who pointed out the national significance of the study and encouraged maximal cooperation.

Post-shelter testing followed a similar schedule of events.

III. Results

A. In-Shelter Tests Results

1. Experimental Variables

Water consumption averaged 1.5 qts./person/day and food averaged 789 cal./person/day (Table 1). Three commodes were sealed off during the study and a fourth started one day prior to exit. Five shelterees defected during the study (see Results, A. 3). Supplies evaluations are presented under Results, A. 9.

2. Shelter Events

The following day-by-day appraisal is based on two sources: (1) a general account of the day's events taken from observer logs; (2) a social sketch taken from an analysis of the daily diaries. (A more detailed analysis of the diary data is presented under Results, A. 5. b.)

The analysis derived from twice-daily diary reports is based on the quantity and quality of the diary records of each shelteree in his position as a fractional instrument of measuring group morale. When the significant majority (75%) of subjects reflected a particular mood or attitude (depression-elation; socialization-withdrawal; anxiety-tranquillity), it was interpreted as the predominant feeling of the group at that time.

"Depression" was inferred from the diary writings by comparatively small amounts of written material, themes of despair or wanting to leave, expressions of home sickness, and expressed lack of interest in shelter activities. The opposite picture received an "elation" evaluation, i.e., expressions of euphoria or emotional excitement.

"Socialization" was judged in terms of the frequency with which each shelteree mentioned some other person in his diary, i.e., another person in the shelter. Participation in games, or expressed interest in them, that the shelteree recorded gave further evidence for concluding that he was group-oriented. Expressions of

annoyance with the activities of others, desire to be alone, retreat from organized activities, and paucity of diary writing were the criteria for the "withdrawal" classification.

"Anxiety" was judged to be predominantly operant when the members made references to anticipating release from the shelter, the number of days remaining, or their frustration over being deprived of some long-standing activities (smoking, going out with friends, etc.). When the subject suggested that his tolerance limit was being approached, further weight to this "anxiety" interpretation was added.

Satisfaction expressed with the circumstances, attention to making in-shelter living more comfortable, and absence of specific complaints were the bases for assigning the group an evaluation of "tranquillity."

Sat. 16 Feb.

Observer log abstract:

Group entered the shelter at 6:40 P.M. Shelter manager gave an orientation on use of shelter supplies and outlined general plan of the day. Cardboard sleeping mats were distributed, as well as food and water.

Diary analysis abstract:

Since the shelterees have been confined for a matter of only a few hours, it is easy to understand the indications of good will, moderate socialization, and somewhat high anxiety that characterize the group at this time. A few people seem to be slightly withdrawn or adopting a reserved attitude toward their fellow shelterees. A notable feature is that in spite of the recency of their acquaintance with each other, there appears to be strong suggestion of a unity in group thinking. This alignment of attitude might be described as a "we're-going-to-beat-the game" spirit. Those few individuals who seem to have reacted in a strongly negative manner to their confinement do not appear to be giving full overt

expression to it, for fear that the group will not be very accepting of such feelings.

Sun. 17 Feb.

Observer log abstract:

(First defection) In the morning the first defection occurred (#18, 39-year old male). (Shelteree defections and reasons are discussed under Results, A. 3). The group was removed from the shelter at 7:20 A.M. for collection of blood samples. Worship services were held later in the morning, followed by a relaxed recreational program, e.g., group sing, spelling bee, riddles. The first 24-hour urine collection began at 12:00 noon. Afternoon activities consisted of making games, such as decks of cards and checker boards, out of notebook paper belonging to school children, rest and naps. The second shelteree defection occurred at 7:50 P.M. (#1, 10-year old female). Complaints of toilet odor began, and persisted throughout the study. Shelterees slept at night on a sexually segregated basis, as suggested by a female shelteree and adopted by the group.

(Second defection)

Diary analysis abstract:

Feelings of slight elation that appeared upon entry into the shelter seem to have diminished. Shelterees appear to be considering the long task ahead as one calling for a great amount of endurance. A few remain somewhat anxious; conversely, a very few give evidence of keeping their spirits elevated. There seems to have been a number of attempts to get to know one another. In fact, this socializing tendency is the most dominant feature at this time.

Some of the extremes of mood that are now in evidence possibly can be traced to the defection of two shelterees. In the evening, a great many feel depressed, almost everyone feels anxious, and there appears to be a failing of the emphasis on socialization noted in the morning's diaries. Very few people are managing to remain unchanged since the time of their confinement; those that have, seem to be the older members of the group.

One or two members manifest extremely high anxiety, and some others show increasing amounts of depression. It might be expected that the most enduring aspects of these personalities are now coming out after the novelty of the first several hours of confinement has worn off.

Chief diary complaints are toilet odor, hardness of floor, and temperature being too hot.

Mon. 18 Feb.

Observer log abstract:

(Third defection) At 0900 the third defection occurred (#6, 11-year old male). Exercise periods, recreational periods, random activity, typify the day's activities.

Diary analysis abstract:

It is difficult to distinguish any extreme forms of poor adjustment in the morning diaries. Most everyone seems to have slight traces of anxiety, but nowhere is this effect noted in excess degree. A few people are making real efforts to socialize but they are in the minority. Probably their efforts have been hampered by the group's sagging spirits. The older members of the group appear to be tolerably accepting their confinement.

In the evening, there does not appear to be much surface anxiety by any member of the group; those that have displayed any anxiety actions are no longer members of the group, having exited. No one seems to be in great need of socializing with the exception of No. 9 who constantly plays the role of a social leader. There is a moderate amount of good will, and moderation at this time certainly indicates some realistic perception. That is to say, the Ss appear to be doing their individual best to keep up their own spirits without depending a great deal on other members of the group or without expressing many needs to encourage their fellow shelterees.

Tues. 19 Feb.

Observer log abstract:

(Fourth defection) At 0815 fourth defection (#7, 12-year old female) occurred. Group complained of movable wall being pushed in when defectees leave. Toilet odor is bad. First commode was sealed off in the evening. Cardboard sleeping mats are being used by some as cover while asleep. Discussion groups during day focus on various topics, e.g., law and politics. Shelterees #36, 7, [illegible], 17, 19, and 11 are emerging as leaders. Morale appeared high at end of the day.

Diary analysis abstract:

In the morning there is evidence of minimal socialization, greater depression, and generally high anxiety. This is probably due in part to mounting physical complaints which take the form of chronic pains and aches incurred by the rigorous in-shelter circumstances. Even the older members of the group seem more agitated, and they are displaying more than their usual reactions of discontent.

As the day goes by, spirits change considerably from the lag of the morning. Some seem quite happy. The majority of people are engaged in activity that contributes to better adjustment. Those people who have shown slight evidences of depression do not seem to be so prone in the evening.

Wed. 20 Feb.

Observer log abstract:

Random activities such as card playing, children studying, group singing characterize the day. Morale appears high at end of day.

Diary analysis abstract:

One can easily distinguish morning diaries from evening reports in that each tends to emphasize factors

consonant with diurnal activities such as sleeping, eating, boredom, etc. Of those people who are making some effort to socialize, most belong to the upper age group. The evening is characterized by moderate socialization, good spirits, and varying degrees of anxiety. Some appear to be in a state of high anxiety while others appear to be very well adjusted. The younger children seem to be the most anxious; some of the group appear somewhat placid, while others seem to be becoming more irritable.

There were several requests for a Bible.

Thurs, 21 Feb.

Observer log abstract:

Temperature seems to have been too cold during the night just past. Adjustments were made accordingly. Training lectures have considered blast, fallout, and radiation. Shelteree #5 wants to leave. Second 24-hour urine collection was begun at 12:00 noon.

Diary analysis abstract:

In the A.M., some persons are socializing a great deal; others, withdrawing into themselves; and a few are indicating their spirits have dropped considerably from the previous night.

Group spirits are slightly elevated during the day. A few appear somewhat reluctant to report much about themselves, thus making a group evaluation difficult. A certain amount of apathy appears to have arisen, except in the case of the younger people who now appear to be adjusting to a maximal level.

Several complain of cold temperature during the previous night. The women are becoming acutely aware of self-body odor and dirt.

Fri. 22 Feb.

Observer log abstract:

(Fifth defection) Training session was conducted by the medic on biological effects of radiation. Shelteree #5 (13-year old female) defected at 1:25 P.M. Sanitary napkin supply was reported depleted, and a new supply was sent in. Shelteree #3 (10-year old female) is emerging as best-adjusted child, appearing to have a good influence on adults. Shelteree #36 is responsible for devising a bingo game; he also has made several decks of cards for the group. The group appeared temporarily depressed in the morning, but spirits have risen by the end of the day. Major activity is the planning for a "Christmas party" for "25" February.

Diary analysis abstract:

What may be characterized as a "conquering attitude" over their own resistances and negative feelings about being confined is evident. The group almost to a person is in very good spirits by end of the day, though some few manifest mild feeling of depression. They are socializing, not very anxious, possibly relying on one another to reinforce their feelings that they will be successful in finishing their task. One person (#5) however, is not volunteering much information. She is slightly depressed, withdrawn, and seclusive. It is interesting to note that she will have left by tonight. Since she never appears to have been a "star" in the group, it is possible that others are not adversely affected by her withdrawal and low morale.

Sat. 23 Feb.

Observer log abstract:

Recreational activities took up most of the day, e.g., cards, bingo, rook, singing. Toilet odor is bad. The second commode was sealed off in the evening. Cardboard mats appear to be beginning to wear somewhat. The

group has been relatively inactive.

Diary analysis abstract:

Anxiety is greatly increased. There is little interaction among the shelterees during the day. Morale seems at its lowest ebb during the day, but rises at night. The group is anticipating a "Christmas party" tomorrow as a recreational diversion.

Sun. 24 Feb.

Observer log abstract:

Religious services were conducted in the morning. Later, the children were very active, wrestling, etc. Adults appear quiet and rather listless. A "Christmas party" was held in evening, celebrating "Christmas Eve," the next day being the "25th" of February. The Christmas tree was cut from cardboard, decorated with paper figures, and put on the wall. Morale was rising toward the end of the day.

The shelter manager has been concerned about gases forming in sealed off commodes, wondering about possible explosion of the plastic liners. The children were very rowdy in morning. The shelterees "bathed" with a little of the drinking water, using surgical soap from the medical kit. The children were promised candy by adult shelterees if they eat their food rations, to which incentive they have responded well. Shelteree #17 wrote a Christmas Poem.

Diary analysis abstract:

In the morning, social isolation remains very evident; anxiety is high. The resistance to group participation of some shelterees does not seem to have bothered others in the group.

Food is the common topic in almost all diaries.

Mon. 25 Feb.

Observer log abstract:

Activities consisted of training lecture, exercise, and games in the morning and afternoon. The third 24-hour urine collection was begun at 12:00 noon. Irritability has been evident. Shelteree #36 gave a short talk and appealed to the group to suppress temper and hostility. No medicine was given today to anyone. Men and women voluntarily segregated into two groups during the day.

In the evening Secretary Pittman and staff observed the group. Mr. Pittman wrote a message, to be given the shelterees the next morning.

Diary analysis abstract:

In the morning, the end is in sight, and the group shows it. They do not seem to hold in check excitable behavior, which n doubt centers around getting out of the shelter. It is too early for any real euphoria to be evident, however. They are mildly depressed and do now show much sign of needing to talk with each other or seeking one another's company.

By evening, spirits are not appreciably lifted and anxiety certainly is not diminished. There is movement toward avoidance of one another except for the usual few who give vent to their gregarious needs.

The women are concerned about body odor and attempting to clean up as best they can. Food continues to be popular diary item. Some shelterees express desire for a better-planned day.

Tues. 26 Feb.

Observer log abstract:

Secretary Pittman's message was received with great interest and read several times by the shelter manager at group request, then posted on the wall.

Friendly relations have developed between #38 (36-year old male) and #21 (46-year old female), #36 (34-year old male) and #17 (37-year old female), but no manifestation of over sexual behavior has occurred.

Diary analysis abstract:

Mr. Pittman's message and the proximity of the end of the study are creating a morale boost, reflecting in the general tone of the diaries. The chief complaint is the toilet odor. All are looking forward to shelter emergence.

Wed. 27 Feb.

Observer log abstract:

Spirits have risen. Group has become more active, with several individual performances in games and singing (#11, 17, 9). The third commode was sealed off at 9:00 P.M.

Diary analysis abstract:

As usual, spirits are low on arising in the morning, but toward evening the depression lifts.

In the morning, one would expect that group morale would be quite high, but this is not the case. Most unchanged are the increased state of anxiety. The changes that are occurring, although slight from the previous evening, are not favorable.

By evening, anxiety is not diminished; but depression appears to have lifted, and the people once again seem to have a genuine interest in one another. (All along, a few shelterees, especially the middle-aged group as opposed to the younger and older shelterees, have shown that this study has not been easy for them to endure.)

Thurs. 28 Feb.

Observer log abstract:

The fourth and last 24-hour urine collection started at 9:00 A.M. The group was given the Post-Shelter Questionnaire in the afternoon. The day was rather quiet. Several have shielded their eyes from interior overhead lights, with no attempt made to use the lighting control panel. Cardboard mats have gotten more ragged. Children spent over an hour studying. A flood of good will and high spirits appeared in the evening, probably in anticipation of release in the morning. Shelteree #17 compiled an "Honors list," e.g., most cooperative, cleanest looking, etc., providing a lively group discussion.

Diary analysis abstract:

The group reflects anticipatory pleasure of morning release, tempered by an aura of sadness that it is their last night together.

Fri. 1 March

Observer log abstract:

The fourth commode was sealed off. The shelterees began to exit at 8:30 A.M.

3. Defections

Five defections occurred during the first week. One 39-year old adult (#18) left after one night, apparently because he never intended to stay; he had been very uncooperative during the pre-shelter testing and an immediate defection had been predicted. This individual was also psychologically unstable; he is presently receiving treatment at the Milledgeville State Hospital. Four of the seven children defected also in the first week, one (#1, 10-year old girl) apparently because her uncle (#18) had left and perhaps because of a general aversion to floor, food, and water, although specific remarks could not be elicited. Another child (#6, 11-year old boy) left because of a psychological reaction

to the blood taking and aversion to the food, and the other two (#7, 12-year old girl; #5, 13-year old girl) because of apparent emotional instability

General reasons for defections are presented in Table 5.

4. In-Shelter Medical History

A daily Medical Complaint Record was kept by the shelter medic listing the date, time, shelteree number complaint, diagnosis, treatment and outcome. The medic did not hold "sick call" but was rather available when needed. Two shelterees agreed to the medic's custody of prescription medicine, being taken prior to shelter entry and to be continued during the shelter stay. Shelteree #19 (41-year old woman) was on estrogen medication for a previous hysterectomy, and #9 (16-year old girl) was on a prescription ointment for mild dermatitis.

A summary of main complaints is presented in Table 6. Headache, the most predominant complaint, constituted half of all complaints. Next was nausea and vomiting, which, however, ceased after the third day. Cessation of nausea complaints was partially due to shelterees who defected early and partially due to recovery by shelterees who remained. Cold and sore throat complaints were minor. Other complaints not listed in Table 6 but noted in the detailed medical record were dysmenorrhea (one shelteree), diarrhea (one shelteree), toothache (one shelteree), wart (one shelteree), and homesickness (one shelteree).

5. Shelter Reactions

Shelteree attitudes and evaluations were assessed by three instruments: (1) a Shelter Entrance Questionnaire completed prior to shelter entrance, (2) an unstructured Shelter Diary sheet filled out twice daily during confinement, in the morning and in the evening, and (3) a Post-Shelter Questionnaire administered on the afternoon of the last day in the shelter.

Table 5

Defections in Experimental Study II

Time	Day	Date	Shelteree Number	Sex	Age	Reason
0830	Sun.	17 Feb.	18	M	39	Never intended to stay.
1950	Sun.	17 Feb.	1	F	10	Did not like floor, food, water. Temperature too hot. Said very little. (Probably uncle #18 leaving was also a factor.)
0900	Mon.	18 Feb.	6	M	11	Did not like food - tasted like dog food. Too hot. Too crowded. Blood test made him sick.
0815	Tues.	19 Feb.	7	F	12	Sick, vomited. Food not good. (Father later said she gets nauseated if excited.) Outside medic reported dehydration from vomiting. She wrote a paranoid poem later about shelter experience (people killing her, etc.).
1325	Fri.	22 Feb.	5	F	13	Crowded, homesick. No one her age in shelter, felt bored. Food bad. In-shelter medic reported crying episodes, withdrawal, cigarette habituation, speech lisp impediment, poor home life. Outside medic reported emotional stress of inexperience with menstruation, and occurrence of such during shelter stay.

Table 6

Summary of Primary Items on Medical Complaint Record[a]

Day	Number of Shelterees Complaining[b]			
	Total	Headaches	Nausea	Cold or Sore Throat
Feb. 17	11	10	2	0
18	3	1	3	0
19	9	4	2	2
20	6	2	0	1
21	6	1	0	1
22	1	1	0	0
23	5	1	0	4
24[c]	0	0	0	0
25	[illegible]	0	0	0
26	1	1	0	0
27[c]	0	0	0	0
28	1	1	0	0
Mar. 1[c]	0	0	0	0

[a]Detailed daily Medical Complaint Record is given in Appendix H

[b]Each shelteree counted but once per day despite any repeated complaint

[c]No medical complaints on these days

a. Shelter Entrance Questionnaire

This form was intended to measure the motivation and anticipation regarding the shelter experiment, as well as general information and preparedness relevant to a nuclear emergency.

Primary motives for participation were to learn more about nuclear survival and to help the national defense effort. However, more than half of the group were presently unprepared for possible nuclear attack and fallout hazards.

Primary discomfort items anticipated by one-half or more of the group were: sleep conditions, lack of exercise, and lack of bathing facilities.

b. Shelter Diaries

Clearly stated "likes" and "dislikes" were tabulated from the morning and evening diaries. Figure 1 depicts the general trends for these two factors across the two weeks. Complaints outnumber the likable aspects of shelter life, as expected; however, the number of daily complaints diminishes toward the end of the study. Possible reasons are adaptation to discomfort, as well as the shelterees believing it unnecessary to repeat complaint factors once stated. Figure 2 compares frequencies of morning and evening complaints.

Morning diaries, with three exceptions, contain relatively more complaints than evening reports. Possible explanations are that the greatest felt discomfort factors occurred at night and would therefore be reported in the morning diaries, and that shelterees felt relatively poorer in the mornings than in the evenings and so would complain most in the morning reports. Figure 3 contrasts morning and evening "likes," with the greatest number reported in the evening. This finding is in accord with interpretations already discussed.

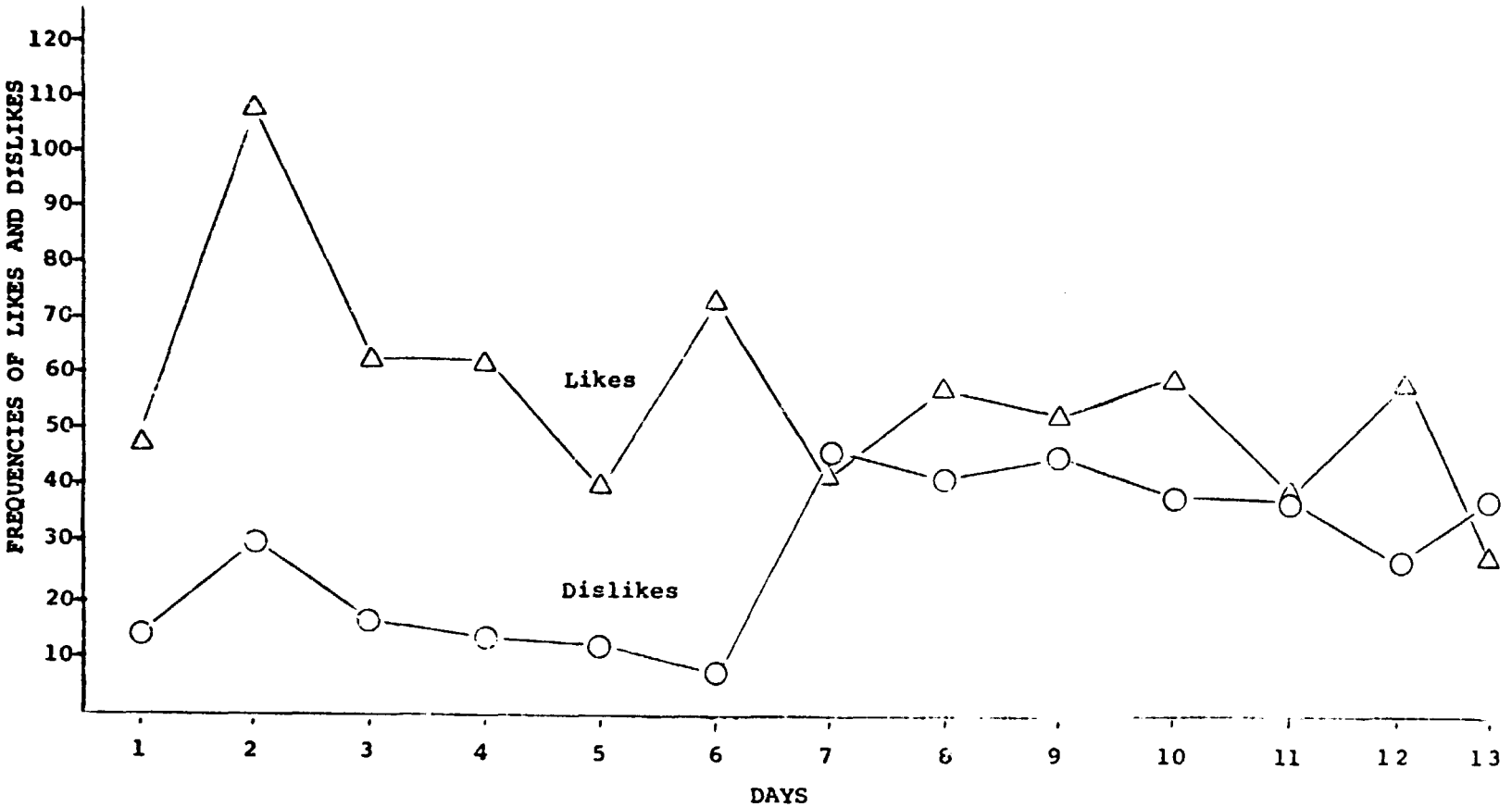

Figure 1 Frequency of likes and dislikes abstracted from diaries ove- total confinement (Experimental Study II)

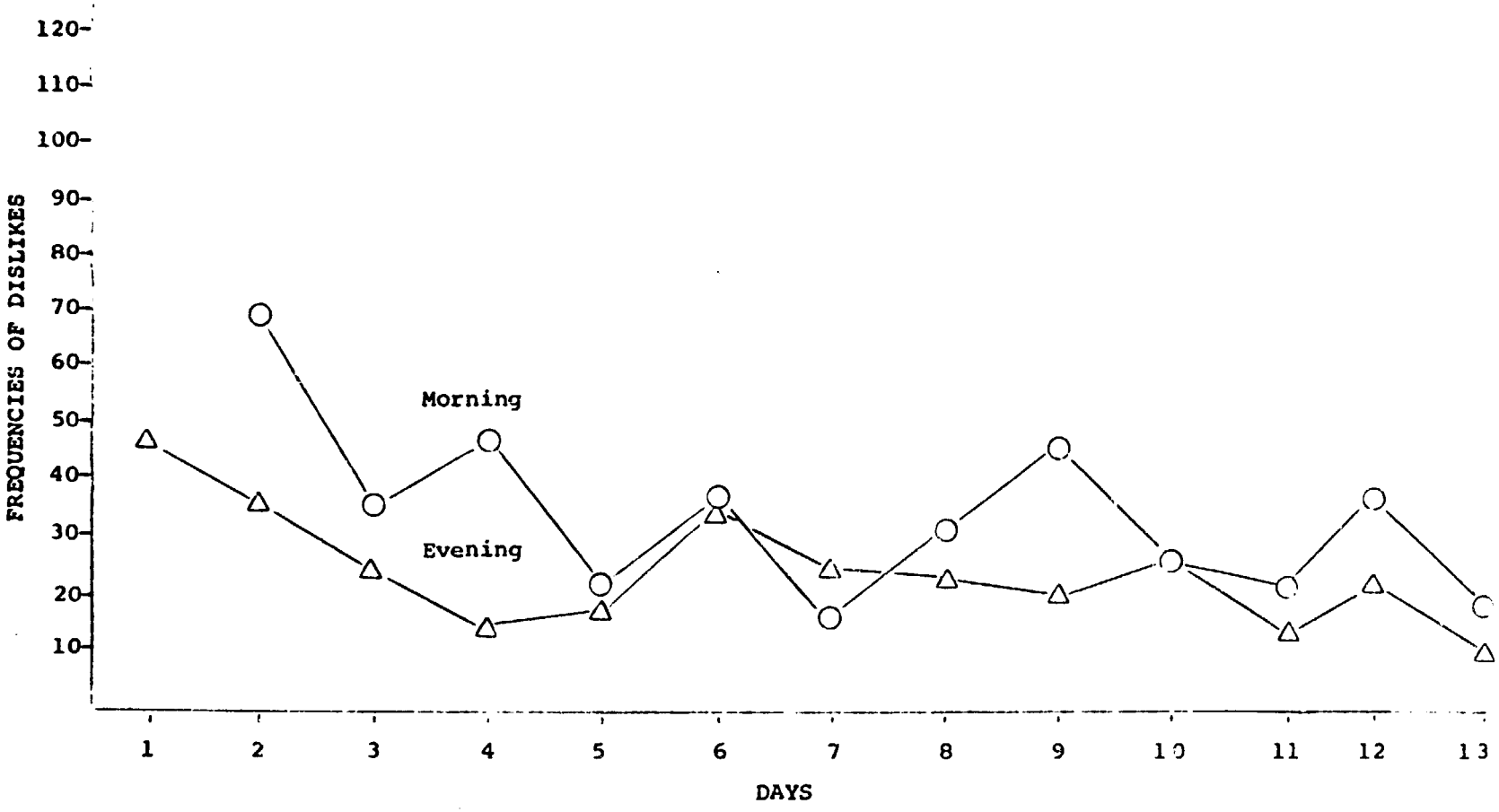

Figure 2 Comparison of dislikes for morning and evening diaries over total confinement (Experimental Study II)

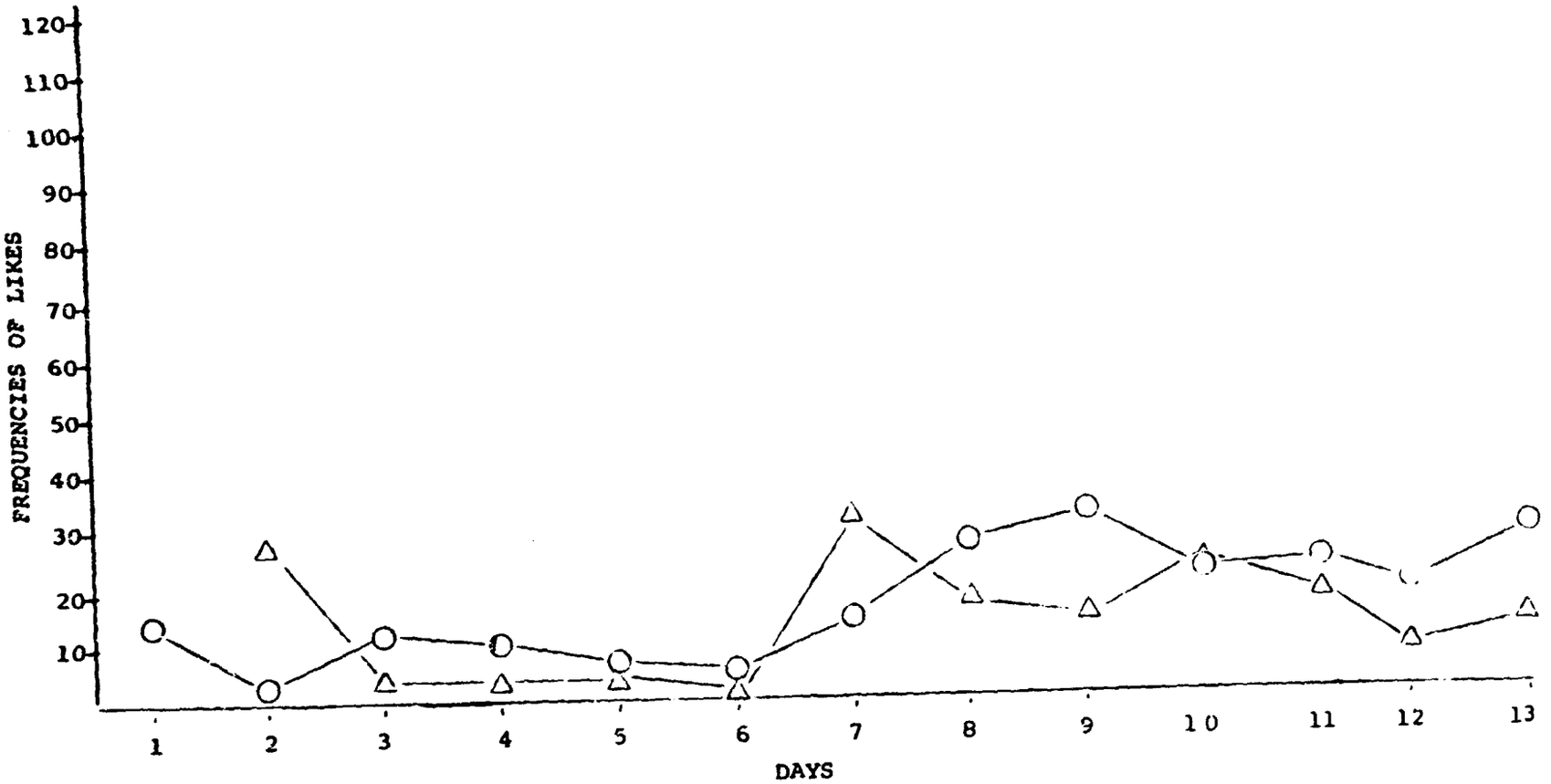

Figure 3 Comparison of likes for morning and evening diaries over total confinement (Experimental Study II)

Tables 7 and 8 list the nature of the dislikes and likes reported. These data concur closely with, and are amplified in data obtained from the Post-Shelter Questionnaire, discussed under Results A. 5. d.

c. Shelter Manager Report

The shelter manager submitted a report a few days after study completion (8 May, 1963). Since the report is brief and comprehensive, it is presented here in entirety rather than abstracted:

"Upon first entering the shelter, the group was noisy and boisterous. This behavior persisted throughout the first night and began to diminish during the next day or two. The first night, everything said was thought to be funny and laughed at.

My first night of sleep was the most difficult of the two-week stay. The heat, being in a strange place, the hard floor, and the close proximity to strange people were some of the things which kept me from getting much sleep. Also, the constant whispering and talking of others during the night made sleep almost impossible.

For the remainder of the two weeks, I had at least four hours of good sleep every night, and most nights many more. Differences in sleeping habits caused minor irritations during the stay. Some persisted in talking until late in the night and wanted to arise late. Others wanted to arise early. These early risers usually woke the rest of the group, and there was bickering on both sides.

Much to my surprise upon having been in the shelter a few days, I found that the space allotted was completely adequate. During the day when there was much activity, there was sufficient space to move around. At night there was adequate space. To a person like myself who occupies a whole double bed at home, the sleeping in close proximity was repugnant at first. But after the first few nights it didn't bother me.

Although there was much complaint on this score (space), I don't think there was anything unbearable about it. It

Table 7

Dislike Factors Abstracted From
Diary Reports of Experimental Study II

Rank	Frequency	Dislike
1	150	Temperature (too cold:82, too hot:68)
2	119	General discomfort and fatigue
3	107	Sleeping conditions (unspecified)
4	69	Crowding
5	63	Lavatory odors
6	48	Food
7	43	Other people
8	35	Hardness of floor
9	19	Dirtiness of self or shelter
10	14	Boredom
11	11	Loneliness
12	8	Water
13	6	Body odor
14	6	Headache
15	5	Lack of cigarettes
16	2	Manager

Table 8

Like Factors Abstracted from Diary Reports of Experimental Study II

Rank	Frequency	Like
1	72	Temperature (unspecified reason:35, warm enough:22, cool enough:15)
2	24	In-shelter activities
3.5	19	Food
3.5	19	Medic
5	7	Manager
6	8	Water
7	5	Other people

was all a matter of becoming accustomed to it. The arrangement of the people in an orderly fashion is the main problem.

The cardboard was, to my mind, entirely satisfactory. It lasted for the entire two weeks and softened the effect of sleeping on the concrete floor. It was also used for cover by some of the shelterees. The first use of cardboard in this manner was during the second night when an older male, #26, became cold, having loaned his shirt to a female child, #3. He took one of the unused boxes and slipped it over his head and shoulders. It apparently afforded him some degree of warmth. Thereafter, use of the cardboard by other shelterees for cover when the temperature dropped was a common occurrence. The cardboard was also used for brooms, checker boards, bingo cards, and to make a donkey for playing pin-the-tail-on-the-donkey.

The survival biscuits, although tasteless at first, tasted better and better as the time went on. At first, several people refused to eat them. Most of these were children who eventually left the shelter. To influence the children to eat, we began a contest to see which child would eat the most, the reward being a box of candy. This had remarkable effect, and I'm sorry it wasn't instituted earlier. It might have possibly kept some of the other children in the shelter.

I had no hunger pangs during the two weeks. In that I had been expecting them, I was pleasantly surprised. The biscuits seemed to fill me. I did notice more gas than usual on my stomach, though. Some of the women never became accustomed to the biscuits and would eat only a few each day. All of the men were hearty eaters.

Meals at first were served five times a day because some shelterees could take only one biscuit a meal. I felt that if it took more meals to make them eat more, then we could afford to do this. After the children began to eat heartily, this was cut to four a day.

Regular schedules were not adhered to at first. The second week, dinner was served at 12:30 P.M. and the afternoon meal at 4:45 P.M. The morning and just before bedtime

snack were left flexible and food was served when enough people became hungry or when they awakened in the morning. This arrangement, I believe, was suitable to most. The only complaints were from hungry people who objected to the rigid schedule of 12:30 P.M. and 4:45 and wanted to eat sooner. The majority seemed satisfied with the schedule.

The one big complaint was the odor from the chemical toilet. Although it was noticeable almost all of the time, I don't rate it as any great discomfort. Certainly if we had not had the air circulation facilities that were present, it might have become intolerable. But as it was, the odor was no worse than is present when outdoor privies are used and lime applied. I think that the odor would have had to be much stronger for anybody to have considered leaving the shelter because of it.

The plastic gloves were indispensable for the tending of the toilet facilities. No trouble was encountered in the sealing off of the toilet. The odor was completely stopped when sealed. One thing I was sure to do when the sealing was done was to allow slack in the top of the plastic bags. I noticed that the chemical did not stop the contents from fermenting, and when the toilet became over half full these bubbles which were coming to the top and bursting created a kind of spray which was disturbing to anyone using the toilet. Medic _____ and I were worried that the gases created after the bag was sealed could conceivably burst it if sufficient slack were not allowed.

The number of sanitary napkins was found to be inadequate. I would recommend that they be stocked in greater quantity. The waterless hand cleaner was more than sufficient. I imagine my failure to give a demonstration as to what "a little on the fingertips" meant was responsible for the large amount used. Also, some shelterees secretly used it as an underarm deodorant.

There were no complaints over the amount of water given for drinking purposes. There were complaints over the method used to dispense it. Some of the men suggested that the water cans could be fixed with nozzles at the bottom and would be better than siphoning. They seemed to think that plastic bags could be easily found with nozzles at the bottom.

The method suggested for siphoning before entering the shelter, that the tube be allowed to fill up and one end closed with the closed end being pulled out of the barrel, seemed to be insufficient. The ordinary method of using the mouth was the easiest and quickest, especially since the water frequently stopped coming through the tube and the process had to be repeated. There was little complaint as to the taste of the iodine in the water. I didn't notice it after the first day.

The language used by the shelterees I think was acceptable. I announced that there would be no profanity in the shelter upon entering, and there was little if any. Some of the men had to be reminded during the poker game to watch their language, but that was the extent of it. Some of the talk did center around things that would not be normal in polite society (body odor, etc.). The presence of young children in the shelter was one of the stablizing factors in holding this down and may well have been the primary influence.

I had no serious challenge to my authority as shelter manager. I thought at first that one male shelteree, #36, was going to do so. But this did not turn out to be the case. Although he was at times loud and boisterous and wanted to do things in a certain way, once I made a decision as to what should be done he never challenged it. In fact, he was the most helpful person besides Medic _____ in the shelter.

The voluntary segregation of the sexes during sleeping hours seemed to have been the idea of the women, and the men acquiesced to the arrangement. This arrangement minimized the problem of romantic attachments. None seemed to arise and any inclinations toward such seemed to be unilateral. In that nothing definite even began in this field, I feel that it would be irrelevant and mere conjecture for me to speculate as to who might have been so inclined under different circumstances.

Cards were made from the heavy paper found in the children's notebooks, and immediately a poker game began. The women seemed to have no objections and, as it was for small stakes, I had none either. The poker games served

as an outlet for the men and occupied their time. They played between two and three hours each day. Rook cards were also made in the same way, and the children and women played this.

The shelterees showed a great deal of interest in the civil defense talks. Each of these lasted approximately 30 minutes. Medic _____ gave talks on first aid and radiation sickness. The group's interest was more than I had expected. They enjoyed discussing things, but often ended up in the irrelevant. If I were going into the shelter again as shelter manager, I would carry more civil defense literature with me and do a more detailed job of lecturing than I did. I just couldn't picture the group absorbing very much of the information, when in fact they were very attentive and really seemed to enjoy the discussions.

Generally, I can say that I will look back on my stay in the shelter as a very interesting and enjoyable incident in my life. During my stay in the shelter, I was never at any time tempted to leave. I had to fight lethargy a good bit of the time. The only time I really felt bad was the first night. I awakened about 3:00 A.M., and it seemed unreal that I was in the shelter. After the first night, I was all right. About the fourth day, I awakened groggy. This condition remained with me one day. Other than these two incidents, I felt fairly normal the entire period.

Of course, the lack of a bath for two weeks created a terrible odor. I didn't notice it on others as much as I did on myself. I found myself avoiding the women because of it, although I knew that it was something common to all the shelterees.

Some suggestions for a more enjoyable shelter life are:

(1) Navy bunk beds which can fold up into the wall without taking up any space should be tried

(2) Pencils and paper should be stocked in all shelters

(3) There should be a deck of cards for every 10 people

(4) There should be more variety in the survival diet

(5) Games such as checkers and chess should be stocked

(6) Reading materials should be available

(7) The chemical toilet should be improved so that no odor but chemical escapes

(8) A songbook with songs for group singing should be included

(9) Some sort of chemical deodorant should be supplied for the shelterees

(10) Water removal from the barrels should be improved

(11) Stock the shelters with blankets and let the temperature stay much lower

(12) Some method should be devised to allow movies to be taken in the shelter without the shelterees seeing the camera moving."

d. Post-Shelter Questionnaire

This form measured possible likes and dislikes of the shelter experience, and an estimate of a projected lengthened stay if such was necessary.

Complaint factors mentioned by at least one-half of the group are listed in Table 9, in terms of numbers of shelterees complaining, and also in terms of relative mean ranking. Primary complaints center on lack of bathing facilities, odors, sleep conditions, and temperature.

Positive aspects of shelteree responses were reflected in the following "like" factors, listed by at least half of the group: contributing to their country, earning money for shelter participation, learning about

Table 9

Selection and Ranking of Major Discomfort Items
by 50% or More Shelterees in Experimental Study II

Item	Rank on Basis of N	N	Item	Rank on Basis of Mean Evaluation	Mean
Lack of bathing facilities	1	21	Chemical toilet	1	1.89
Odors	2	20	Lack of bathing facilities	2	2.67
Chemical toilet	4	18	Sleep conditions	3	3.78
Sleep conditions	4	18	Odors	4	3.90
Uncomfortable temperature	4	18	Lack of space	5	4.25
Lack of space	6	16	Uncomfortable temperature	6	4.72

fallout protection, helping University civil defense research, and learning about shelter living.

When asked to estimate how much longer they could endure their shelter stay, the group averaged 11.4 additional days. Adult males had a higher mean tolerance estimate of 19.9 additional days as compared with the adult female mean estimate of 4.9 more days. The four children estimated 0, 0, 10, and 10 days, respectively. Twenty-two of the shelterees (eleven males and eleven females) said they would have still volunteered for the study if they had known what the conditions would really be like, and three-fifths of the group (nine males and six females) said they thought they might volunteer to stay in a shelter like this again sometime. Consensus of opinion was that the young people found shelter living more difficult than adults, and only seven shelterees (three men and four women) reported that living in the shelter was a difficult thing for them personally.

e. Sociometric Analysis

When asked to name three people whom they would like to have with them in a shelter again, the group selected #14 (the shelter medic, 28 years old), #12 (the shelter manager, 23 years old) and #17 (the shelter teacher, a 27-year old woman). Two persons whom the group rejected as undesirable shelter companions were #26 (the oldest man in the group, 61 years old) and #38 (36-year old man).

Major nominations for good shelter manager potential were #36 (34-year old male), #14 (the shelter medic), and, parodoxically, #38, one of the two rejections. Details of these and other sociometric analyses may be found in Appendix E.

6. Observational Data

Dominant activity pattern measurement was divided into two classes: (1) lying, sitting, or standing (relatively mutually exclusive categories and summing to

approximately 100%); (2) sleeping, exercise, eating, recreation, training, conversation and quiet (not mutually exclusive categories, and therefore not summing to 100%). Frequency counts of the number of shelterees engaged in those activities were made every fifteen minutes.

Figure 4 presents the relative amount of time spent in lying, sitting, and standing positions over the 24-hour day, with hourly means averaged for all days of the two-week confinement period. Most of the waking hours were spent in a sitting position. Figure 5 illustrates the gradual shift in use of these positions over the two weeks. Lying gradually increases, with correlative decreases in sitting and standing. Figure 6, portraying over the two weeks the amount of time engaged in activities such as sleeping, quiet, conversation, and recreation, indicates fairly consistent patterns. Figure 7 depicts the high correlation among the three activities of standing, eating, and conversing. Apparently, shelterees stood up for the primary reason of getting food, and this time also stimulated greater conversation levels. Figures 8 - 13 are composites of a particular activity on four distributed days taken from the two-week period. All indicate consistent patterns. Statistical evaluations and interpretations of any occasional shift are still in process.

7. Environmental Data

a. Temperature and Humidity

Figure 14 graphically presents the mean values and ranges of effective temperature (ET) for each day throughout the two-week shelter stay.

On the basis of the four-day study of Experimental Study I, the initial ET was set at 81°, judged comfortable by that group. However, it became rapidly evident that shelterees in Experimental Study II found this level too warm, and requested a lower temperature. Experimental Group I slept on the uncovered concrete floor, which probably absorbed body heat, and this

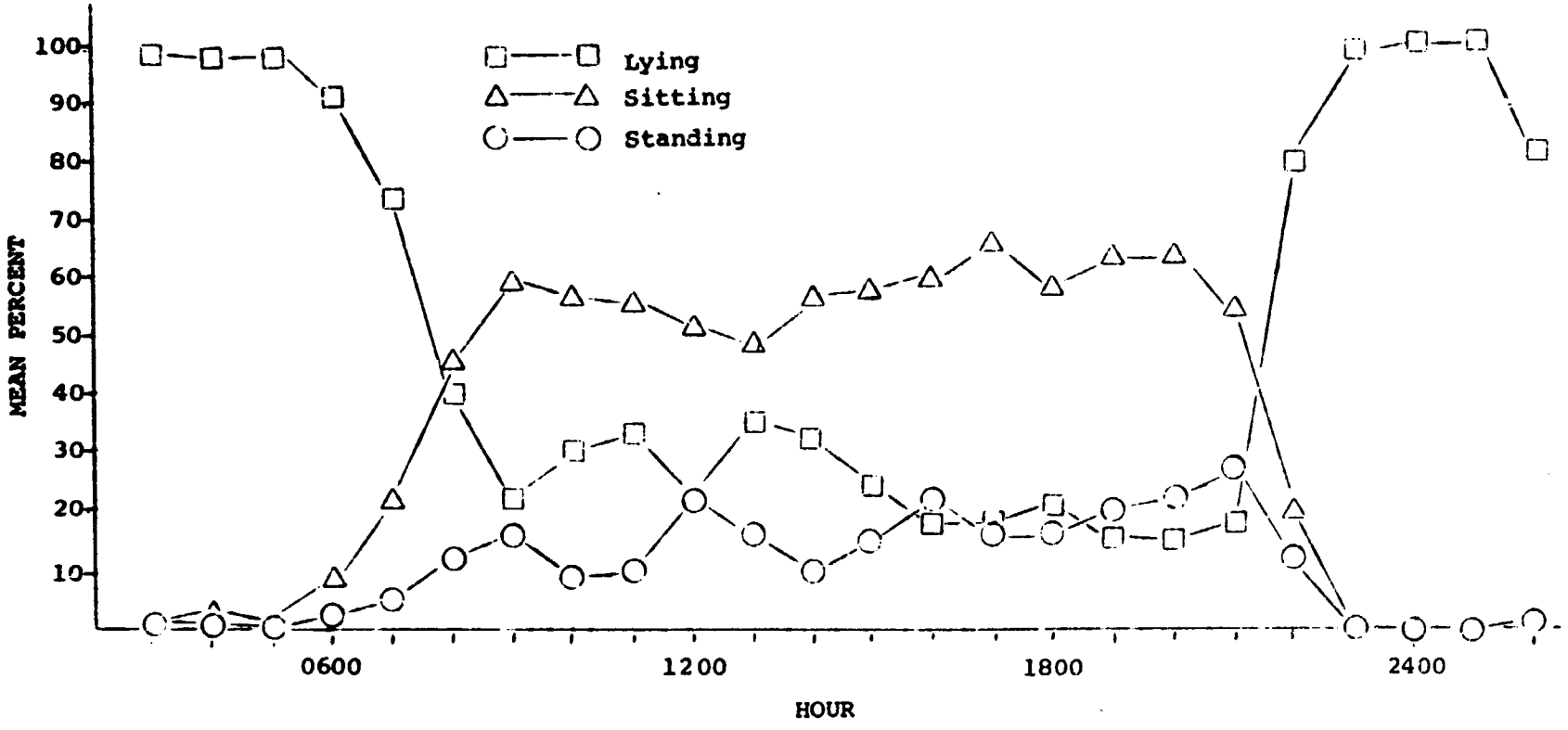

Figure 4 Hourly means for lying, sitting, and standing averaged over total confinement (Experimental Study II)

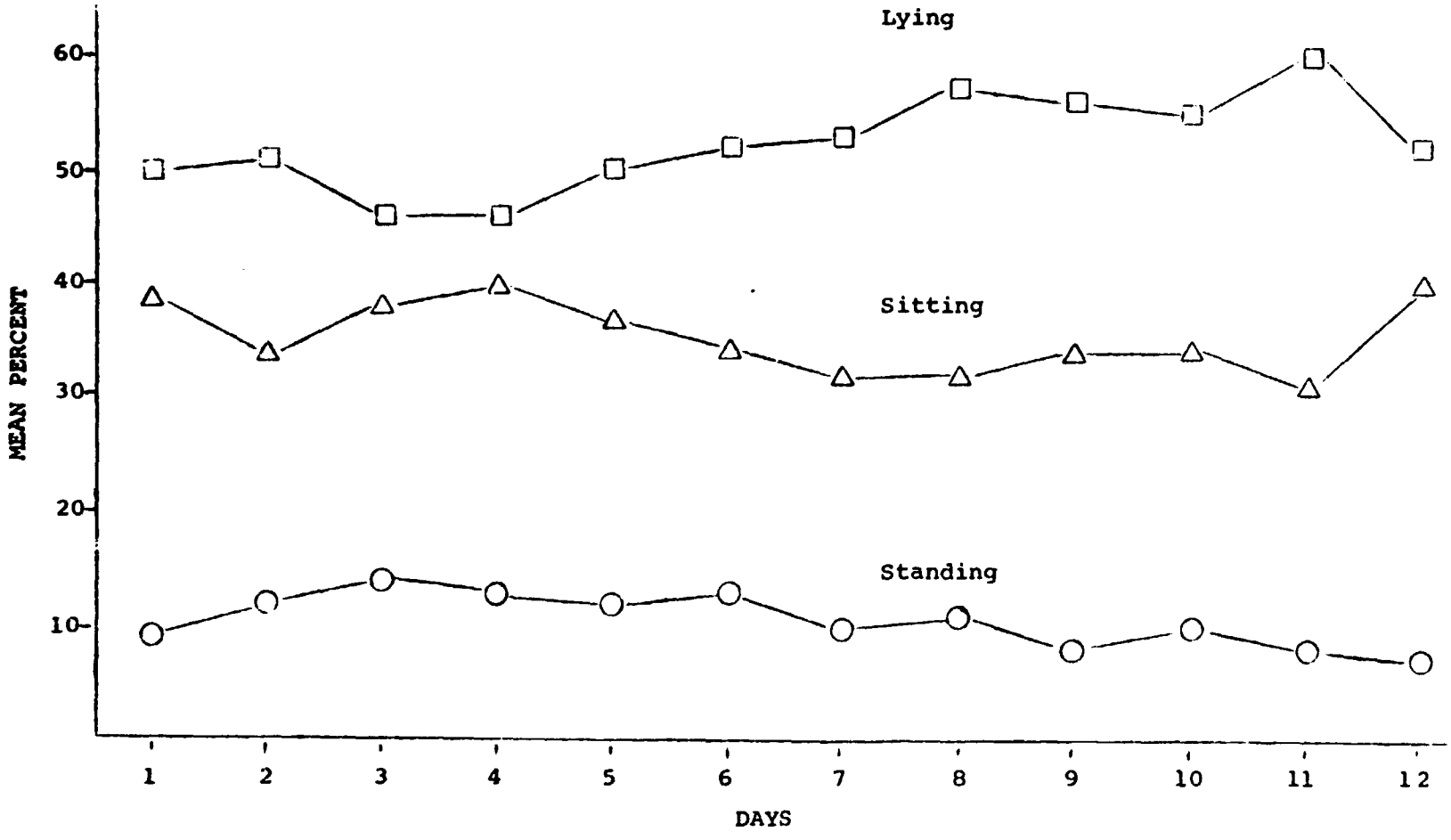

Figure 5 Daily means for lying, sitting, and standing averaged over total confinement (Experimental Study II)

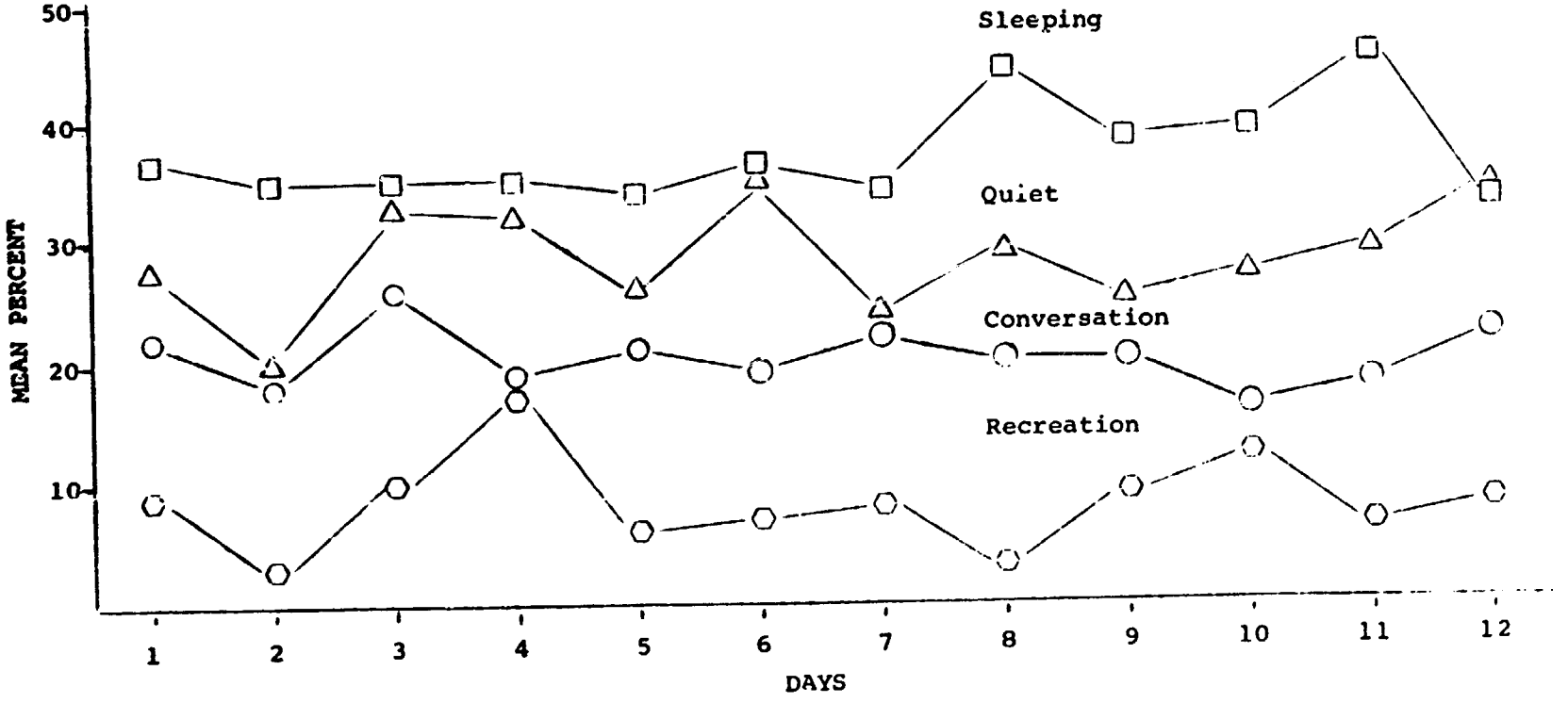

Figure 6 Daily means for sleeping, quiet, conversation, and recreation averaged over total confinement (Experimental Study II)

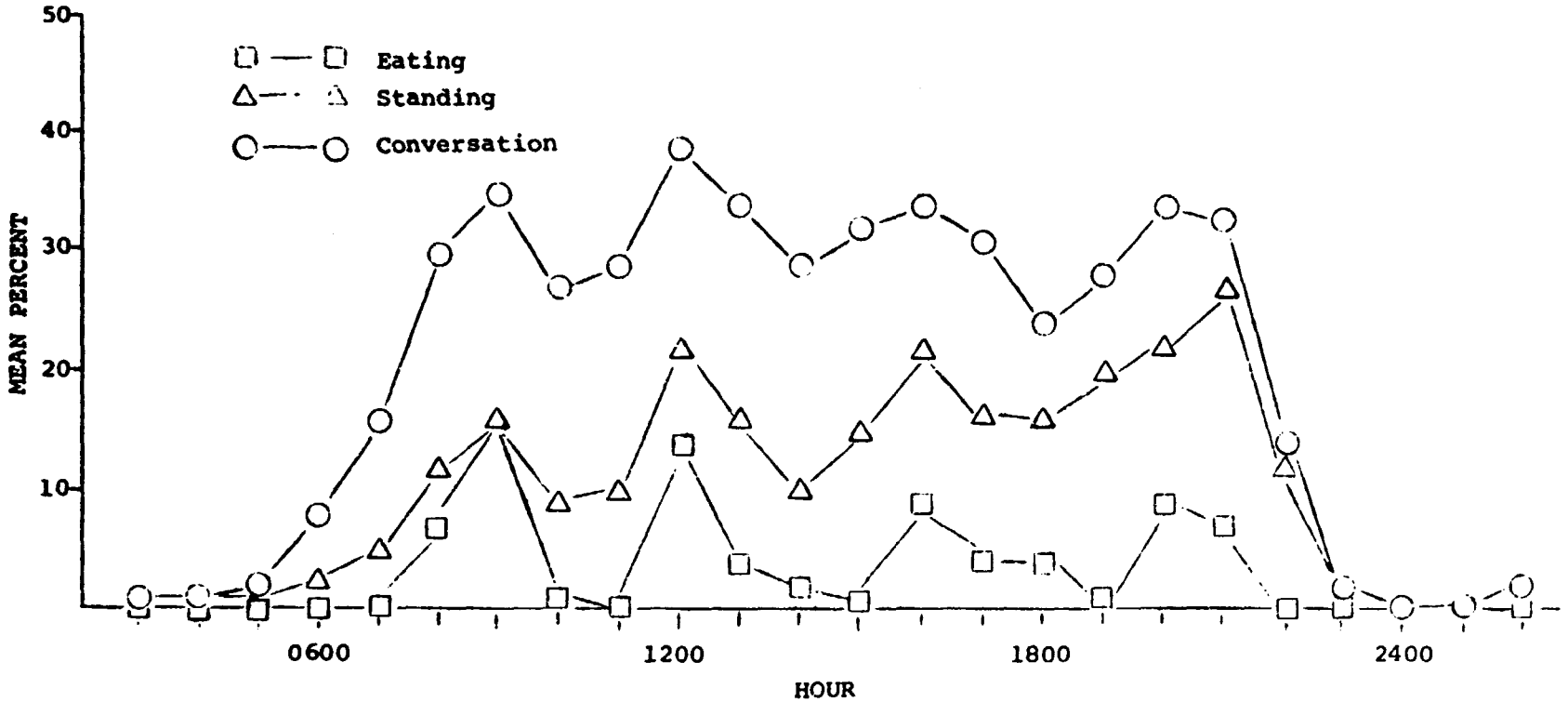

Figure 7 Hourly means for eating, standing, and conversation averaged over total confinement (Experimental Study II)

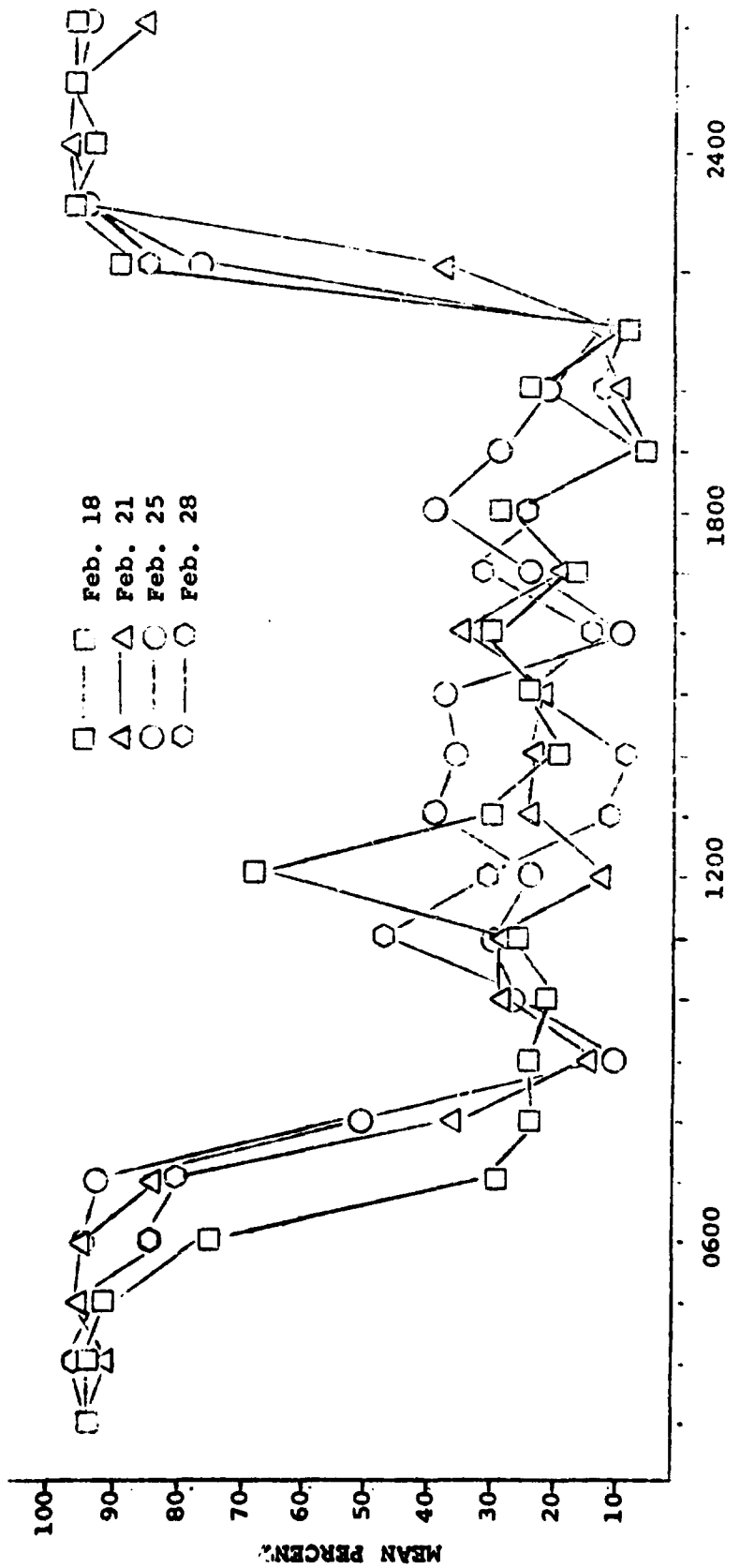

Figure 8 Comparison of four daily lying patterns (Experimental Study II)

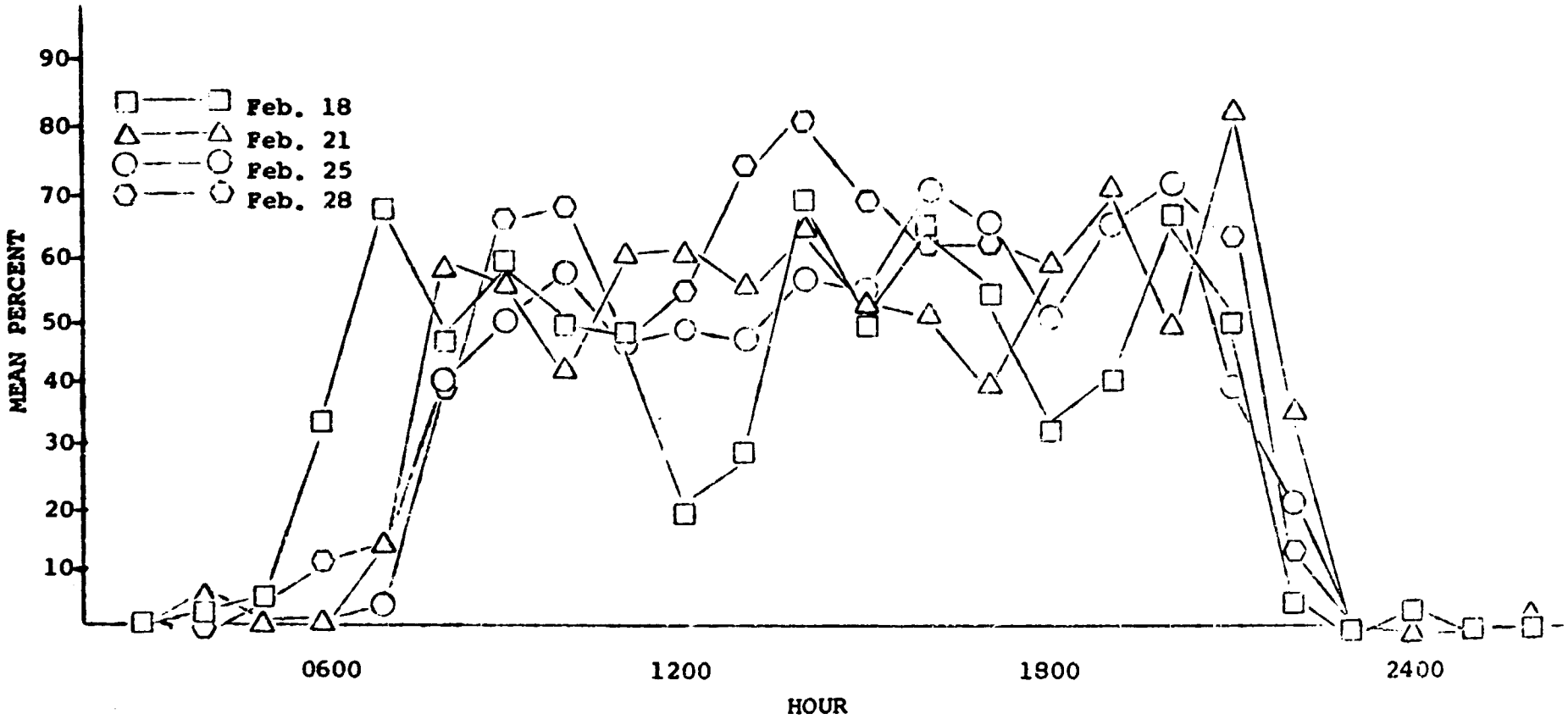

Figure 9 Comparison of four daily sitting patterns
(Experimental Study II)

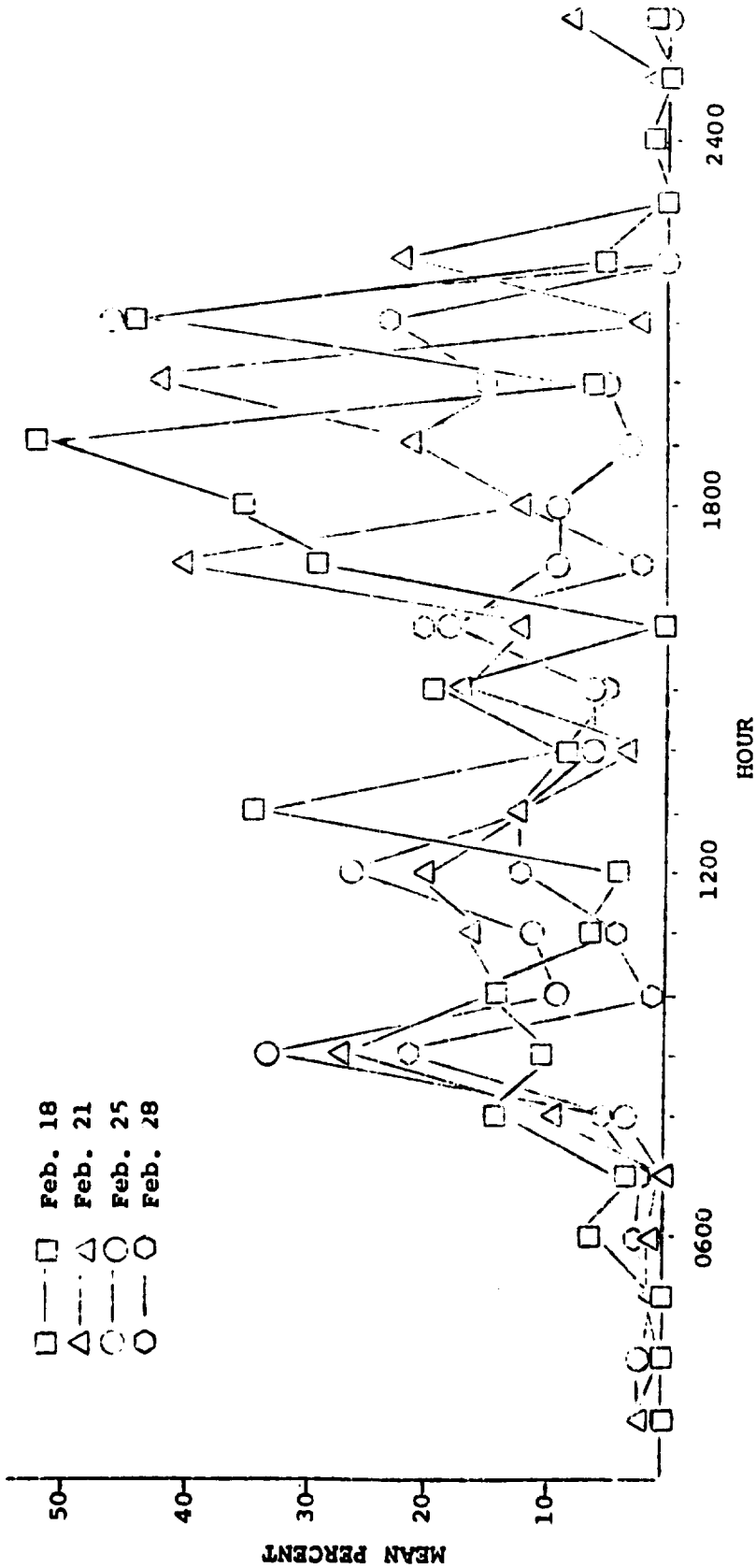

Figure 10 Comparison of four daily standing patterns (Experimental Study II)

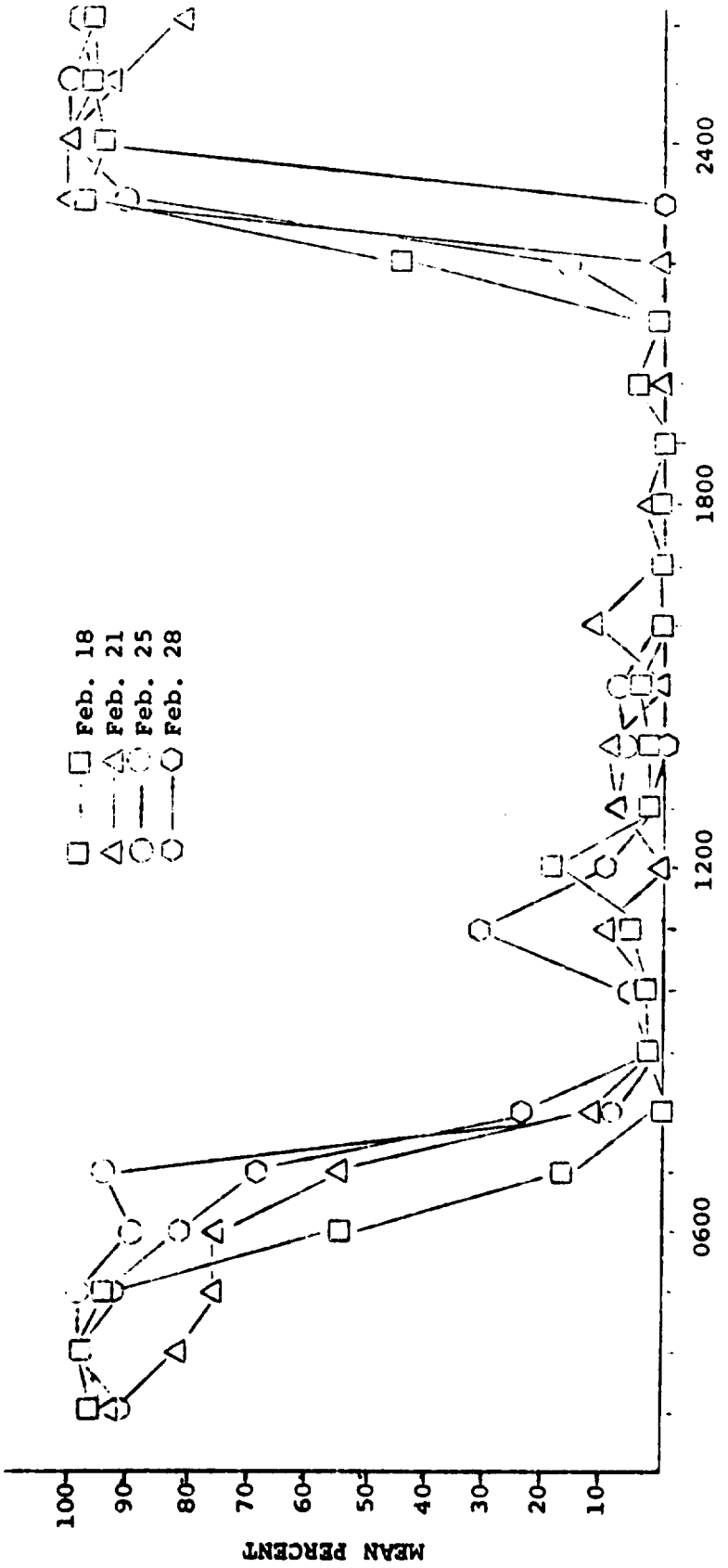

Figure 11 Comparison of four daily sleeping patterns (Experimental Study II)

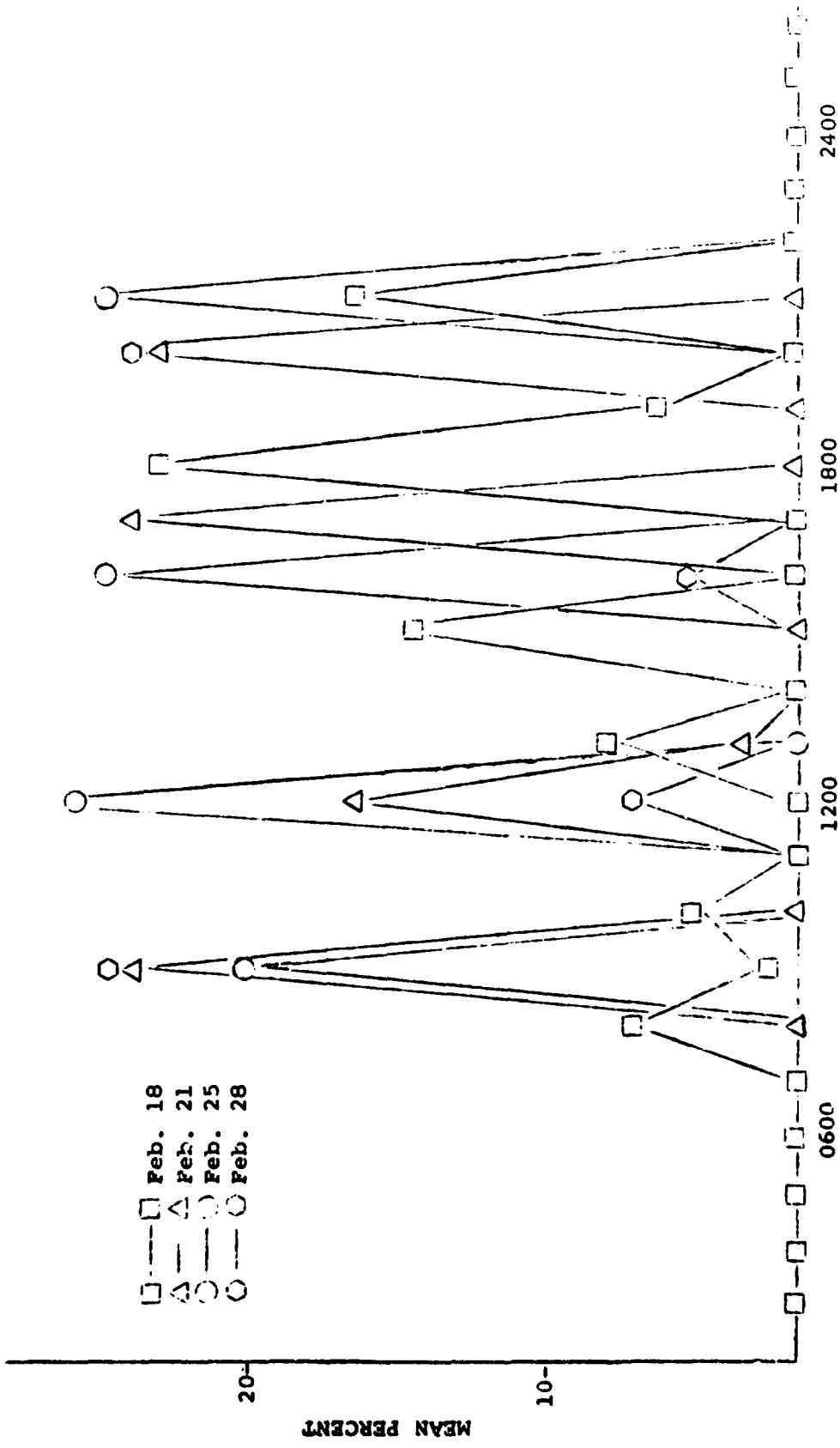

Figure 12 Comparison of four daily eating patterns (Experimental Study II)

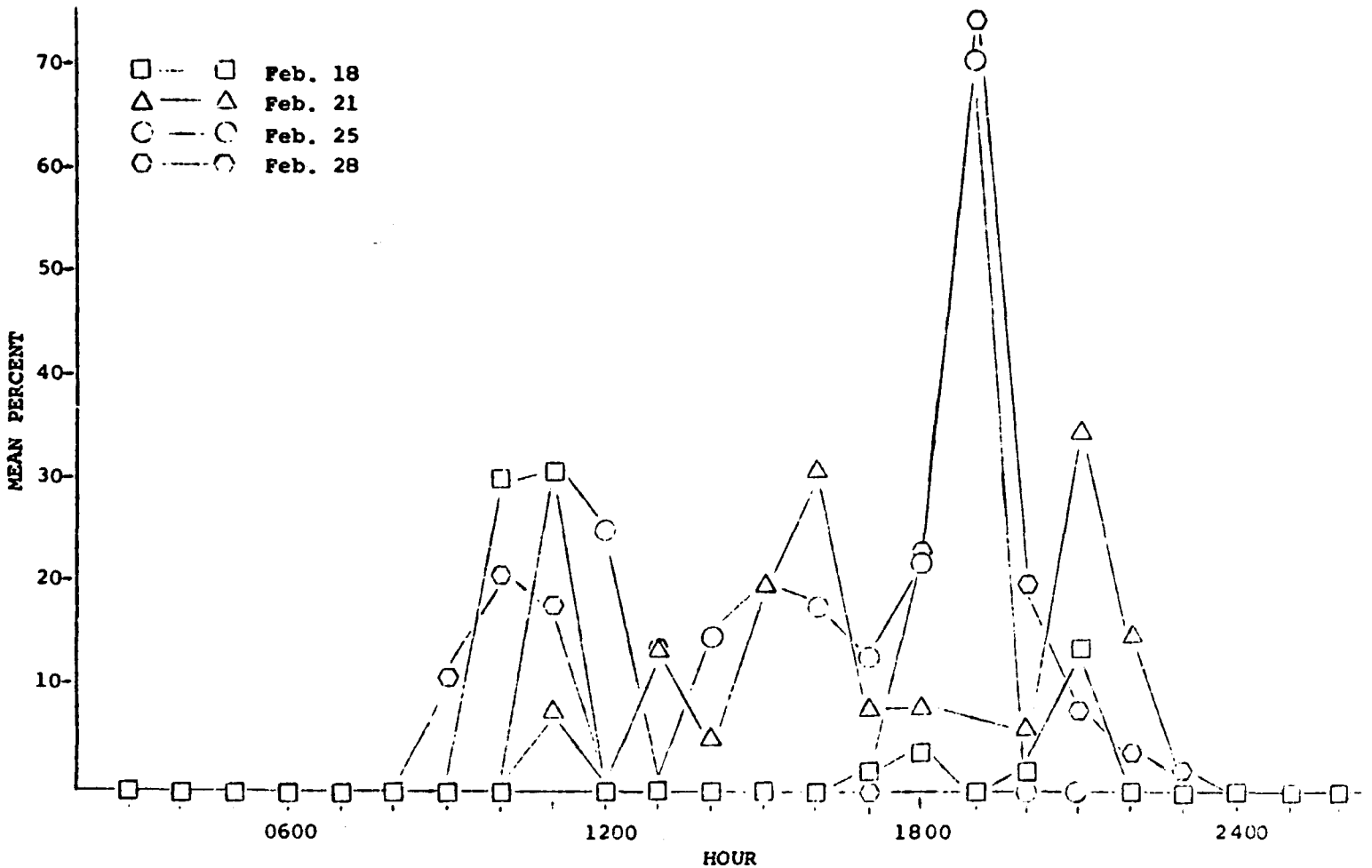

Figure 13 Comparison of four daily recreation patterns (Experimental Study II)

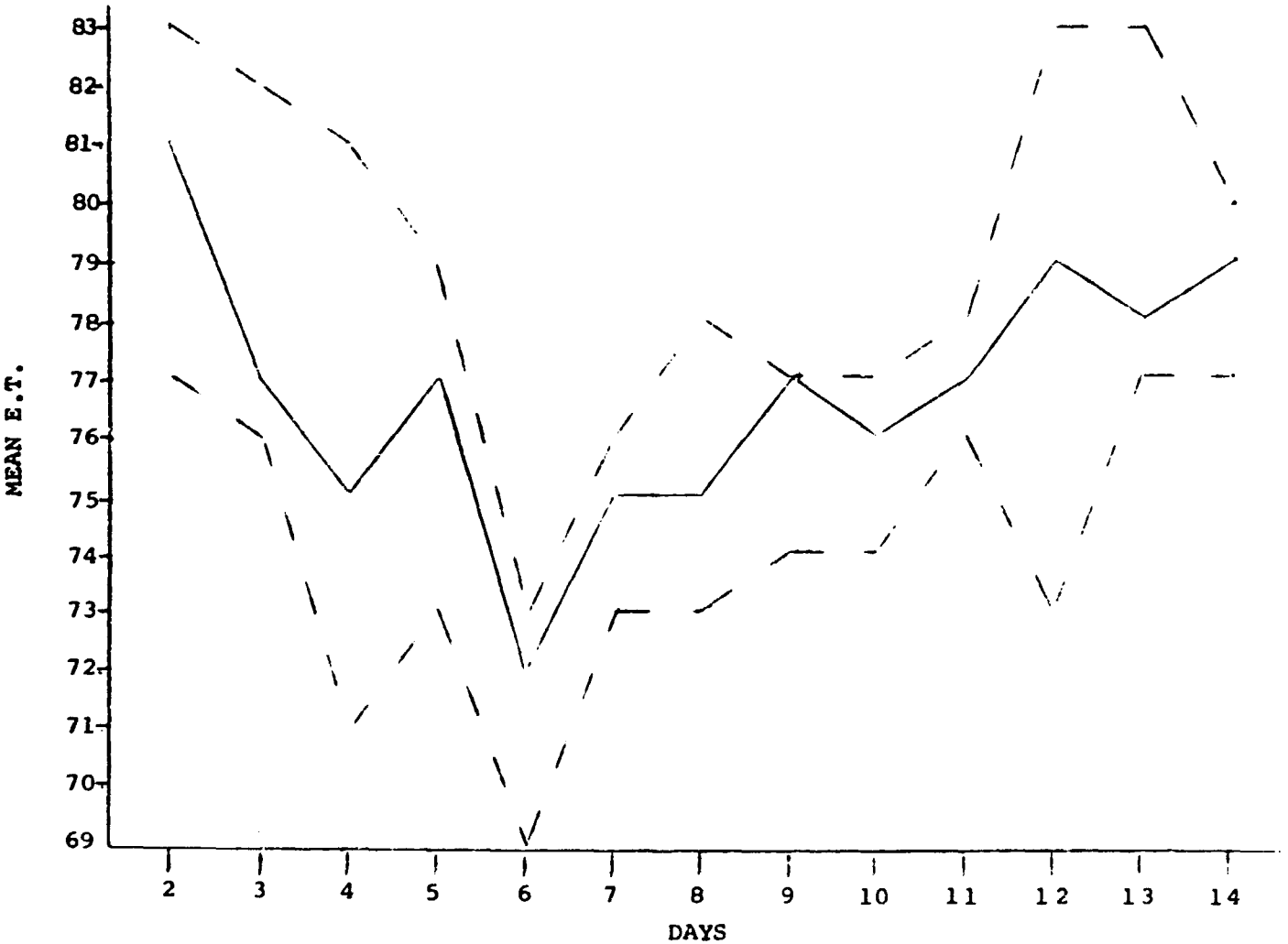

Figure 14 Daily means and ranges of effective temperature (Experimental Study II)

factor, in addition to a lower caloric diet (270 cal./person/day) probably contributed to 81° ET as being comfortable for that group. Experimental Group II, on the other hand, slept on cardboard, which most likely prevented heat absorption by the concrete floor, and in addition this group had relatively more to eat.

Several days passed before a comfortable ET for Experimental Group II was established, and thereafter the requested ET began to rise steadily (Figure 14). Requests for higher temperature levels were probably reflections of the need for additional warmth, consequent to several days on a low caloric intake in addition to fatigue from attempting to sleep on a hard surface.

In order to maintain comfortable temperature levels within the thermal characteristics of the shelter, it was found necessary to increase the day-time ventilation (8 A.M. - 11 P.M.) to 40 cfm/person (8 cfm/person fresh air, 32 cfm/person recirculated air). Night ventilation (11 P.M. - 8 A.M.) was adequate at 15 cfm/person (3 cfm/person fresh air, 12 cfm/person recirculated air).

b. Activity and Noise Levels

By use of an electronic device, general activity levels were measured hourly. The consistency of a daily pattern of activity over the two-week confinement period is presented in Figure 15, depicting activity for four distributed days of the study. The high correlation between activity level and noise level is portrayed in Figure 16. Total daily plot of these two variables is averaged for the entire study. Total daily noise level appears to rise during the first three days, followed by a gradual decline to the end of the study. Total daily activity also gradually declines, but rises sharply at the end of study probably due to activities anticipatory of

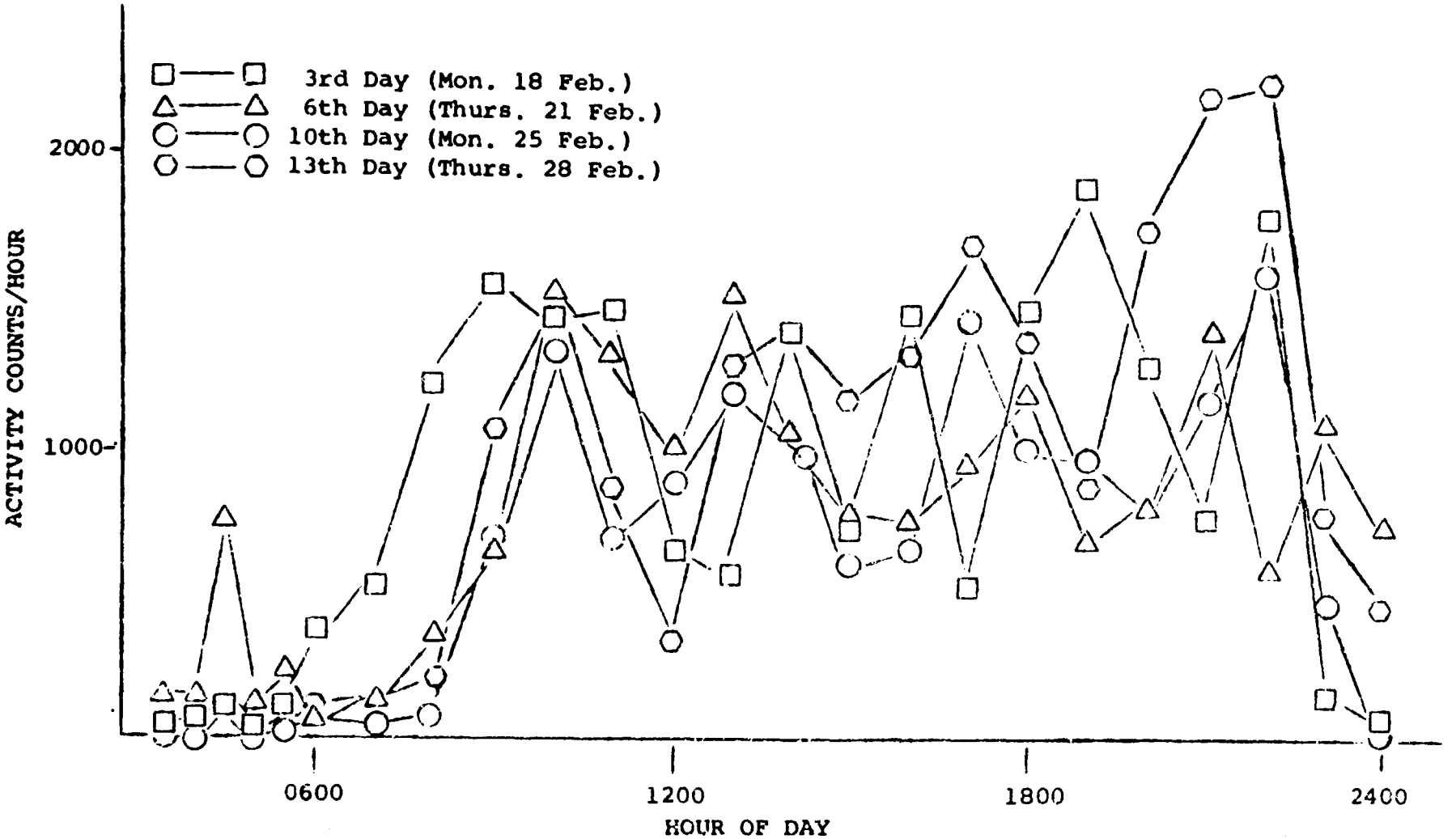

Figure 15 Composite of four daily activity levels (Experimental Study II)

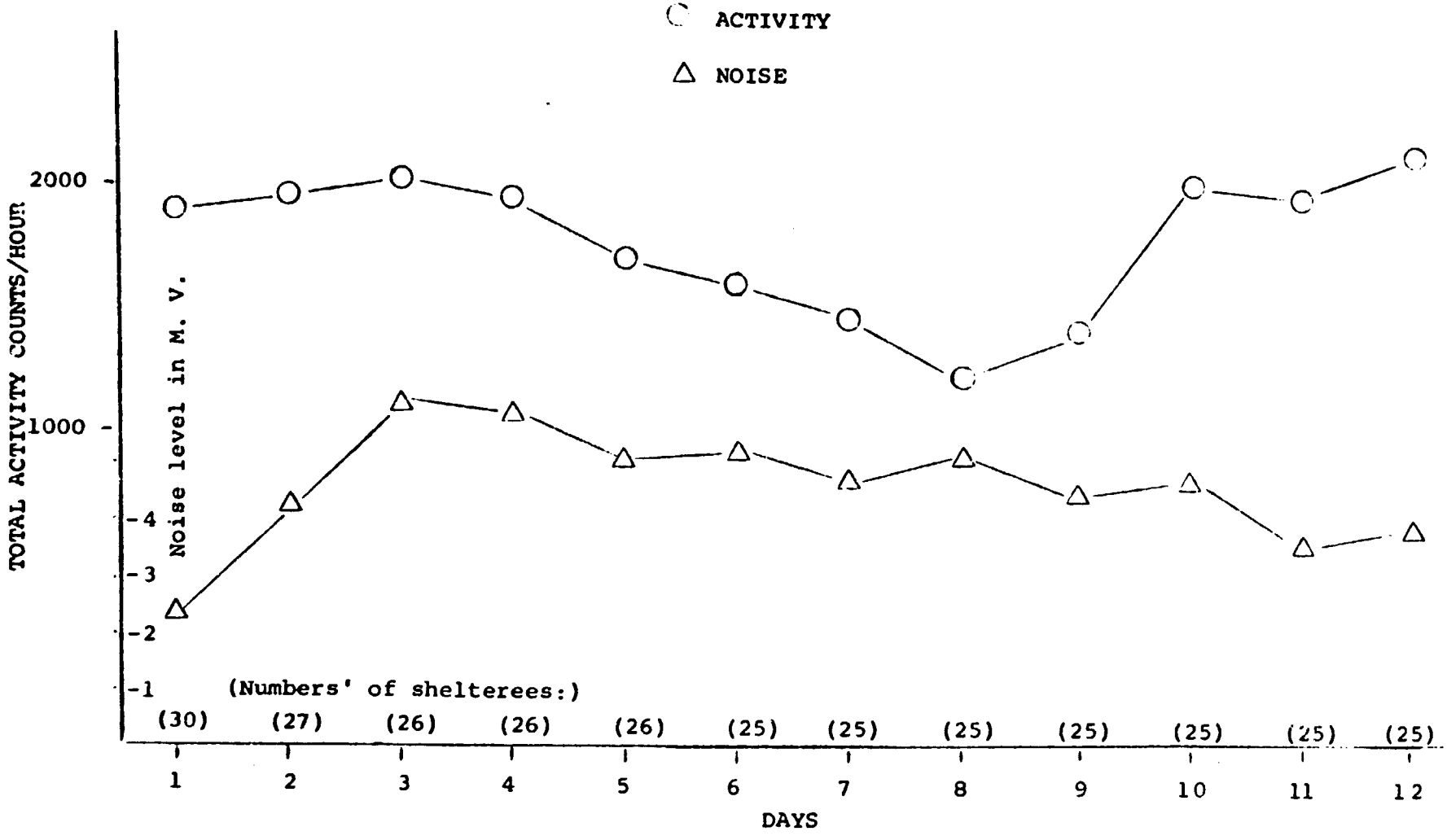

Figure 16 Total daily activity and noise levels
(Experimental Study II)

exit. Figure 17 illustrates activity and noise levels for each hour of the day, averaged over the two weeks. Peaks of activity during the day correspond primarily with eating times and activity preparatory for sleeping. Also, the noise level peaks seem to lag slightly behind activity level peaks. Periods of relatively low activity are associated with lecture and discussion periods (10 A.M. - noon), study and rest periods (2 P.M. - 4 P.M.), and an entertainment period (6 P.M. - 8 P.M.).

8. Nutritional Analysis

The analysis of blood and urine samples is not yet complete. Results will be given in the next quarterly report.

9. Shelter Supplies Evaluation

Although complete results of the nutritional analysis of the food are not yet available, the examining physicians stated they could find no deleterious physiological effects on post-shelter physical examinations.

Shelterees, asked to comment on adequacy of their survival supplies, suggested the addition of items listed in Table 10.

B. Pre- and Post-Shelter Test Results

1. Medical Examinations

None required any form of emergency treatment. All cooperated in the medical examination and interview.

Of those shelterees who completed the study, none suffered deleterious effects. There was, of course, a significant average weight loss of 7.4 pounds (8.0 pounds for males and 7.3 pounds for females). Half this weight loss was recovered within one week after the study, and practically all weight loss recovered within two weeks.

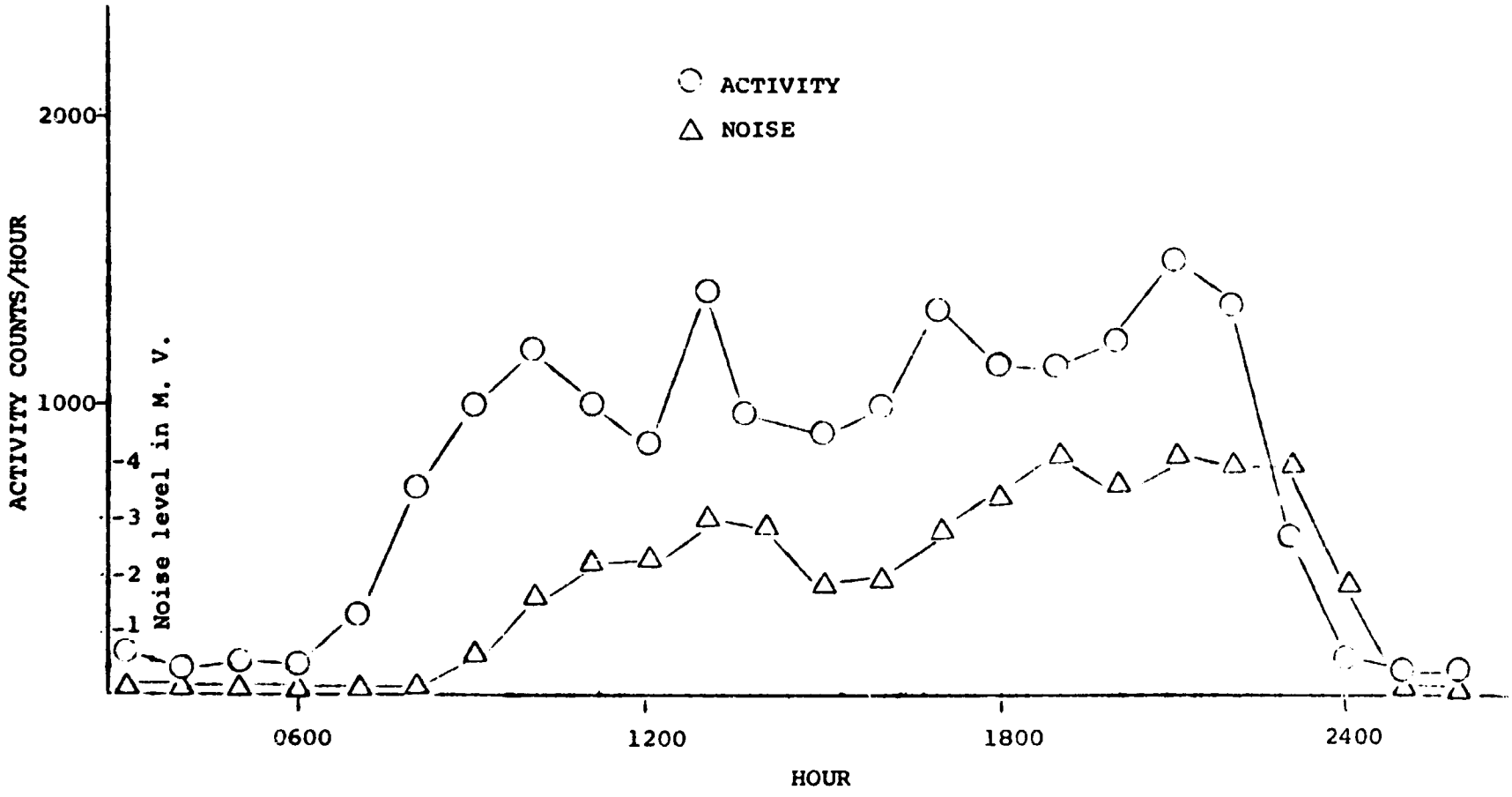

Figure 17 Hourly activity and noise levels averaged over total confinement (Experimental Study II)

Table 10

Suggested Additions to Shelter Supplies
Used in Experimental Study II

Item	Additions	Source of Suggestions
Medical Kit	Anti-nausea medication (in addition to sodium bicarbonate)	Medics
	Medication for hysteria	
	Band-Aids	
	Radiation burn medication (in addition to sodium bicarbonate and petroleum jelly)	
	Antibiotics	
Sanitation Kit	More efficient chemical toilet deodorant	Shelterees
	Clasp on siphon tube to maintain siphon action (e.g., enema hose clip)	Shelter Manager
	More sanitary napkins	
Miscellaneous	Beds, blankets, Bible, paper towels, chairs, broom, storage shelves, cards, checker boards, songbook, fiction	Shelterees

2. Physical Fitness Testing

On the Physical Fitness Test Battery a slight loss occurred in the mean strength index for males, chiefly due to decrease in leg and back strength. Visual motor coordination, as measured by the pursuit rotor and the Flanagan coordination test, appeared to suffer no ill effect from confinement.

3. Psychological Testing

Shelterees of Experimental Group II represent almost as broad a range of mental ability as is found in the general population. General Aptitude Test Battery G scores ranged from 75 to 116 with a median of 102. Performance on the School and College Ability Test confirms the representativeness of the sample and the wide ability range of the experimental group.

Changes from pre- to post-testing on ability measures were minimal and not statistically significant. The three adults who were illiterate and unable to take the paper and pencil examinations earned Full Scale I. Q.'s on the Wechsler Adult Intelligence Scale of 89, 97 and 99. There were no appreciable changes from pre- to post-testing on either the full scale or the sub-tests.

The shelterees' ability to perform mental tasks with speed and accuracy was not adversely affected by the shelter confinement. After two weeks in the shelter all subjects were able to perform operations with numbers and solve mathematical problems as well as they had been able to do upon shelter entry. There was nothing in the psychological testing data to suggest impaired concentration or weakened attention span on the part of the shelterees.

Personality of the group reflected in MMPI and SORT scores did undergo a slight change from pre- to post-testing. At the beginning of the experiment all members of the group were strangers. Consequently, the personality tests might have been perceived as hostile and threatening, producing some guardedness on the self report scales. Males were lacking in deep emotional

response, while females, as a group, were rather socially introverted. On the post-test there was a reduction in the capacity for abstraction, and an increase in facility for dealing with concrete detail. However, none of the personality changes in test scores were of any practical significance.

IV. Conclusions

The following conclusions are indicated by this study:

A. General Conclusions

1. Healthy men, women, and children, aged 9-67, can subsist for two weeks under crowded conditions on water rations of 1.5 qt./person/day, survival biscuit rations of 789 cal./person/day, and sleep on a concrete floor covered only with thin cardboard, without suffering deleterious physiological or psychological effects. Shelterees' average estimate of endurance of an extended stay was 11 days.

B. Specific Observations

1. Shelter Environment

   (a) Limited living space of 8 sq. ft./person and 1 cu. ft./person additional storage is tolerable.

   (b) Cardboard is a satisfactory substitute for bunks as a sleeping surface.

   (c) Chemical toilet deodorant needs improvement.

   (d) Water dispensing method needs improvement, e.g., a hose clip to maintain siphon action.

2. Shelteree Reactions

(a) Five defections occurred during the study, primarily for reasons of emotional instability and initial nausea reaction.

(b) Average estimates of endurance of extended shelter stay for men, women, and children were 20, 5, and 5 days, respectively.

(c) Weight loss averaged 7.4 pounds (8.0 pounds for males, 7.3 pounds for females).

(d) Weight loss was practically fully recovered within two weeks of study completion.

(e) Primary environmental complaints were: lack of bathing facilities, odors, sleep conditions and temperature.

(f) Primary physiological complaints were: headache, nausea, and fatigue.

(g) During the study, the effective temperature was gradually increased in accordance with shelteree request.

(h) Circadian patterns of activity showed high consistency throughout the study.

V. Forecast

Experimental Study III, another two-week occupancy study, was conducted 27 April - 10 May. Variables investigated are presented in Table 11, as well as notes contrasting this group with its predecessor. Evaluation of Experimental Study III data, presently in progress, will be given in the July-September, 1963, Quarterly Report.

Table 11

Variables Evaluated in Experimental Study III
(27 April - 10 May, 1963)

Shelteree Characteristics

Number - Thirty (30), including a trained shelter manager
Age - 7 to 70
Sex - 15 males, 15 females

Shelter Environment

Space - 8 sq. ft./person (52 cu. ft./person)
- 1 cu. ft./person storage additional
Temperature - optimal
Humidity - optimal
Ventilation - (a) night: 15 cfm/person from hours 2200 - 0800 (3 cfm fresh air, 12 cfm recirculated air; (b) day: 40 cfm/person from hours 0800 - 2200 (8 cfm fresh air, 32 cfm recirculated air).

Shelter Supplies

Water - 1½ quarts/person/day
Food - 900 calories/person/day (Nabisco biscuit)
Sanitation - Sanitation Kit III
Medication - items from Medical Kit A
Radiological Kit
Bunks - none; will sleep on floor
Blankets - none
Recreational materials - none
Washing water - none
Coffee - none
Cigarettes - Smokers will be permitted to bring one pack of cigarettes for the shelter stay.

NOTES:

1. An inshelter nurse will be provided in Experimental Study II. In addition, a standby physician will be on 24-hour call, as in previous studies. All shelterees will receive physical examinations before and after shelter confinement.

2. Ventilation during the night will be 15 cfm/person but during the day will be 40 cfm/person. The increase during daylight hours was found necessary in Experimental Study II

to keep rising temperature from becoming a stress variable. Temperature will be kept optimal and controlled in Experimental Study III as not to confound the effects of stress variables under investigation.

3. Water rations of 1 qt./person/day in Experimental Study I were found to be inadequate, whereas 2 qts./person/day in Experimental Study II were more than adequate for drinking purposes. Consequently, 1½ qts./person/day will be evaluated in Experimental Study III.

4. Food rations of 1,000 calories/person/day of the bulgur wafer was found to be adequate in Experimental Study II. The same rations will be provided in Experimental Study III, in an evaluation of the Nabisco biscuit.

5. Certain Medical Kit A items used in Experimental Study II will constitute an abbreviated medical kit for use in Experimental Study III.

6. Shelterees, as in Experimental Study II, will again sleep on 3/16-inch cardboard pallets placed on a concrete floor. However, the amount of cardboard available will be reduced 50% in Experimental Study III.

7. The commode chemical used in Experimental Study II was found to be ineffective under the conditions of the study. In Experimental Study III, various combinations of new chemicals will be tested.

Appendix E

Experimental Study III

Table of Contents

Abstract

A second two-week simulated fallout shelter occupancy study under austere habitability conditions was conducted by the University of Georgia Psychological Laboratories from 27 April - 10 May, 1963.

Thirty shelterees, 15 males, 15 females, aged 7-66, participated. Stress conditions included restricted food and water rations, minimal living space (8 sq. ft./person), a chemical commode, reduced ventilation, and sleeping on thin cardboard placed over a concrete floor. There were no bunks, no blankets, no water for bathing, no coffee, and only one pack of cigarettes permitted per smoker.

Water intake averaged 1 qt./person/day and food consumption averaged 814 cal./person/day. Only two shelterees exited prior to study completion. The remaining shelterees emerged in good physiological and psychological condition.

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List of Figures

I. Introduction

This report is an account of the third in a series of simulated fallout shelter occupancy studies being conducted at the University of Georgia Psychological Laboratories under Contract OCD-OS-62-226. The study, implemented 27 April - 10 May, 1963, is the second two-week study to be completed. The first two-week experiment, described in the Quarterly Report for April - June, 1963, was designated Experimental Study II. The investigation herein reported will be referred to as Experimental Study III.

II. Experimental Design

A. Purpose

Experimental Study III was designed to evaluate the variables listed in Table 1. Both Experimental Study II and Experimental Study III were conducted under conditions surpassing in austerity all previous shelter research involving men, women, and children.

B. Experimental Variables

Experimental Study III differed from Experimental Study II in the following respects:

1. An in-shelter nurse was substituted for the in-shelter medic.

2. Ventilation during the night was 15 cfm/person, and during the day 40 cfm/person. The increase during daylight hours was found necessary in Experimental Study II to keep rising temperature from becoming a stress variable. Temperature was optimal and controlled in Experimental Study III as not to confound the effects of the stress variables under investigation.

3. Water rations of 1 qt./person/day in Experimental Study I were found to be inadequate, whereas 2 qts./person/day in Experimental Study II were more than adequate for drinking purposes. Consequently, 1½ qts./person/day were evaluated in Experimental Study III.

4. Food rations of 1,000 cal./person/day of the bulgur

Table 1

Variables Evaluated in Experimental Study III
(27 April - 10 May, 1963)

Shelteree Characteristics

Number - Thirty (30), including a trained shelter manager
Age - 7 to 66
Sex - 15 males, 15 females

Shelter Environment

Space - 8 sq. ft./person (52 cu. ft./person) (includes latrine area)
- 1 cu. ft./person storage additional
Temperature - optimal
Humidity - optimal
Ventilation - (a) night: 15 cfm/person from hours 2200 - 0800 (3 cfm fresh air, 12 cfm recirculated air); (b) day: 40 cfm/person from hours 0800 - 2200 (8 cfm fresh air, 32 cfm recirculated air)

Shelter Supplies

Water - 1 quart/person/day consumed out of 1½ qts./person/day provided
Food - 814 calories/person/day (Nabisco biscuit) consumed out of 900 calories/person/day provided
Sanitation - Sanitation Kit III
Medication - items from Medical Kit A
Radiological Kit
Bunks - none; slept on floor
Blankets - none
Bible
Recreational materials - none other than crayons and children's school texts
Washing water - none
Coffee - none
Cigarettes - Smokers were permitted to bring one pack of cigarettes for the shelter stay
Watches - none (no way of telling time)

wafer were found to be adequate in Experimental Study II. Nine hundrod calories were provided in Experimental Study III in an evaluation of the Nabisco wheat-flour biscuit.

5. The OCD Medical Kit A used in Experimental Study II was abbreviated for use in Experimental Study III.

6. Shelterees, as in Experimental Study II, slept on 3/16-inch cardboard pallets, measuring 5' x 2' when opened, placed on a concrete floor. However, the amount of cardboard available was reduced 50% in Experimental Study III, subsequently covering about 60% of the floor area.

7. The commode chemical Weladyne used in Experimental Study II was found to be ineffective under the conditions of the study. In Experimental Study III, different amounts of Weladyne were tested, and a test series of different commode chemicals initiated.

8. Shelterees were not permitted to take in watches or time pieces.

Experimental Group III was similar to Experimental Group II in space, temperature, humidity, absence of bunks or blankets, sleeping on a concrete floor on corrugated cardboard mats 3/16-inch thick, absence of coffee and washing water. Smokers were permitted to bring in with them one package of cigarettes, or 1 3/8 ounces smoking tobacco with pipe, or five cigars.

Children were permitted to bring in textbooks, paper, and pencil for study purposes, some of which were unavoidably used as recreational materials, e.g., Robinson Crusoe. The shelter manager brought in a box of crayons through a misunderstanding, since no recreational materials were supposed to be provided for the study.

Shelterees were permitted one change of underwear and socks or stockings and toilet articles such as toothbrush, toothpaste, mouthwash, and handbag cosmetics. Items excluded were wrist watches, clocks, food, candy, soap, shaving gear, eating or cooking utensils, and pillows or blankets.

C. Shelterees

Publicity and recruitment procedures have been described in previous quarterly reports.

The subjects who participated in Experimental Study III were selected by random assignment from a pool of 1,153 applications which had been stratified by age and sex. The fifteen males and fifteen females in the experiment ranged in age from 7 to 66. The mean educational level for the twenty adults was 11.5 years (Table 2).

Four of the shelterees were chosen for particular duties. The shelter manager was 27 years old and an active duty USN/SC Lieutenant. One shelteree selected for the study was a 24-year old public health nurse. Another shelteree who had training and experience as a Civil Defense Nursing Assistant was appointed as the secondary nurse. Finally, an advanced doctoral candidate in clinical psychology acted as a psychological observer.

The adult males included two farmers, a poultry plant worker, a shoe-cutter, a radio instructor, and an office manager. Most of the women were housewives, although three were regularly employed. In addition to the registered nurse, there was also a textile worker and a library clerk. There were ten children, five boys and five girls, between the ages of 7 and 15. All of the children were enrolled in school at the time of the study.

D. Pre- and Post-Shelter Testing Procedures

Pre- and post-shelter testing for Experimental Study III consisted of a medical examination, a physical fitness battery, and psychological evaluation.

1. Medical Examination

Prior to his arrival each shelteree was given a complete medical examination by his family physician. On the day of entry consulting physicians examined each shelteree for current infections and possible respiratory congestion. Blood and urine analyses were also performed. On the advice of the staff physicians two subjects were consequently replaced. The resultant thirty subjects who entered the shelter were in sound health and free of infectious disease.

Table 2

Educational and Occupational Characteristics of Shelterees in Experimental Study III

Shelteree Number	Sex	Age	Education (years)	Occupation
5	F	7	1	Student
7	F	8	2	Student
3	F	10	4	Student
1	F	12	6	Student
31	F	13	6	Student
11	F	24	12	Housewife
17[a]	F	24	13	Nurse
13	F	29	12	Clerk
15	F	31	11	Housewife
19	F	41	1[illegible]	Housewife
29	F	45	9	Textile Worker
21	F	46	14	Housewife
35	F	48	9	Housewife
23	F	51	7	Housewife
27	F	64	13	Housewife
2	M	11	5	Student
6[a]	M	11	2	Student
4	M	13	6	Student
8	M	13	7	Student
36	M	15	7	Student
12	M	27	16+	Student
14	M	27	16	Naval Officer
16	M	34	15	Office Manager
18	M	35	12	Radio Instructor
9	M	38	8	Shoe-cutter
40	M	40	10	Farmer
20	M	42	6	Farmer
26	M	57	8	Chiller Operator
22	M	61	11	Unemployed
30	M	66	8	Retired

[a]Early Exit

2. Physical Fitness Testing

The physical fitness battery for this study was designed to measure not only strength, but also physical endurance, motor coordination, and depth perception. The primary measure of strength was the leg lift, which is an integral part of the Rogers Strength Test.

A modification of the Harvard Step Test was employed as a measure of endurance. Each subject was required to step up on a platform at the rate of 25 steps per minute for a maximum of four minutes, or until he was unable to maintain the cadence. The platform ranged in height from 14 to 20 inches, the height used being determined by the subject's age and sex.

The Pursuit Rotor and the Stasiometer were used for measuring visual-motor coordination. The Pursuit Rotor consists of a turntable with a small disc on the periphery. The object of the task is to track the moving disc with a stylus. The subject's score is determined by the amount of time the stylus is in contact with the target.

The Stasiometer is a test of operational steadiness and eye-hand coordination developed by J. Stanley Gray at the University of Georgia. The subject attempts to pass a small metal ring over a spiraled copper tube without touching the tube. The score is determined by the speed and accuracy of performance.

A beam-walking task was used to measure balance and gross motor coordination. The instrument used was a modification of the Springfield Beam-Walking Test, designed to measure dynamic balance. This characteristic is defined as the postural orientation of the body when the person is performing a specified motor activity which involves relatively large motions of all the body which act to disturb the gross orientation of the person. The beam was 10 feet long by 3½ inches wide. The blindfolded subject was required to walk the length of the beam, turn around, and return to the starting position. The subject's score is a function of both speed and accuracy.

Stereopsis or depth perception was measured by the Keystone Telebinocular, which presents to the examinee a series of symbols, such as a star, a square, a cross, a

heart, and a ball. In each row the subject is required to designate the symbol that stands forth from the others. The score is the number of correct responses.

3. Psychological Testing

Psychological evaluation included measures of intellectual ability and of personality. The California Short-Form Test of Mental Maturity was used for appraising mental capacity. The Minnesota Multiphasic Personality Inventory, administered in previous studies, was again utilized.

4. Pre-Shelter Questionnaire

A Shelter Entrance Questionnaire was given prior to shelter entry to determine general information on anticipations of shelter experience, as well as preparedness for a nuclear emergency.

E. Behavioral and Environmental Measures

1. Observers and Observational Forms

Continuous 24-hour observation was maintained by 2-man observer teams on 6-hour watches. One observer monitored the instrumentation, while the other kept a continuous log on the following activities: (a) Number of shelterees sitting, lying, standing, sleeping, exercising, eating, recreating, training, talking, or quiet; (b) Shelterees emerging as dominant figures or withdrawing as recessive figures; (c) Group activities such as lectures, training, etc.; and (d) Use of equipment in the shelter, e.g., cardboard mats, cups, medical kit items, water and food dispensing, etc.

2. Environmental Measures

Environmental measures included temperature changes, humidity variations, general activity levels, noise levels, and lighting variations.

3. Commode Chemical Tests

A series of commode chemical tests was initiated in

this study. The first tests involved various combinations of Weladyne and water. Other tests were to include the use of various combinations of sodium nitrate, boric acid, sodium perborate, mineral oil, and cupric sulphate.

F. In-Shelter Program

1. Shelter Manager Training

All members of the research staff concerned reached firm agreement upon the individual selected to be the shelter manager. Prior to the study, the shelter manager completed forms and tests relating to background experience, personality, intelligence and possible adaptability to shelter life and leadership. He was a U.S. Naval Officer (Lt. jg) attached as instructor to the U.S. Naval Supply Corps School, Athens, Georgia. He had recently served a year with research teams in the Antarctic and was in excellent physical condition from training for amateur wrestling competition. His chief qualification was perhaps his interest in shelter research and his affiliation with this endeavor.

The week prior to entry the shelter manager was familiarized with many aspects of shelter living and the meager supplies that would be available. He was informed of the results of the previous studies, given many hypothetical situations to examine, and problems that he might have to solve.

The candidate was supplied with a quantity of formal and informal literature that he could use in preparing a series of lectures or training sessions for use in the shelter, and also a list of titles for a guideline in presenting this material.

The shelter manager received ten hours of formal training at the Psychological Laboratories. As described in previous quarterly reports, training was centered on orientation to the experimental situation. The importance of containment of the maximal number of shelter inhabitants was stressed.

2. Activity Program

With few exceptions the shelter program was very similar to that of Experimental Study II. The shelter manager was informed of the findings of previous occupancy groups. He was requested to make a strong effort to keep the shelterees occupied, with emphasis placed upon applying his own and others' ingenuity. Discussions were held with reference to types of activities and times for which these activities would perhaps be most appropriate. The intent was to gain genuine interest and cooperation of as many shelterees as possible under the circumstances.

As in previous studies, a pre-structured, rigid schedule was avoided to attain maximum flexibility. The shelter program was thus to a great extent an emergent variable dependent upon social interplay between the shelter manager and the shelteree group.

The shelter manager was a more authoritarian personality than previous shelter managers and had a broad military leadership background. It was therefore anticipated that the resultant shelter program would be more structured and rigid than any previous study. This expectation was later confirmed.

The shelter manager upon entry immediately began organizing and controlling his environment. A "shepherd - flock" relationship developed and continued throughout the experiment. Through prayer, religious services, lectures, discussion, and individual contact, the shelter manager elicited maximal shelteree cooperation. The shelter experience was presented to them as a test of spiritual, physical, patriotic, and creative endurance. To this challenge, the group responded well and admirably.

G. Schedule of Events

Arriving at the Psychological Laboratories at 8:30 AM on 27 April, the shelterees were received by staff members and oriented on the day's proceedings. Medical examinations were followed by physical fitness and psychological testing. Later in the day the group was addressed by the Project Director on the national significance of the study. At 4:30 PM the shelterees entered the shelter.

Post-shelter testing followed a similar schedule of events.

III. Results

A. In-Shelter Test Results

1. Experimental Variables

Water consumption averaged 1 qt./person/day and food consumption averaged 814 cal./person/day (Table 1). Five commodes were sealed off during the study.

Only two shelterees defected during the two weeks (see Results, A. 3). Evaluation of supplies is presented under Results, A. 9.

2. Shelter Events

a. A Typical Shelter Day

No unnecessary movement or talking were to commence until the signal for awakening was given by the shelter manager. His signal was the brightening of the room by the light switches. This generally occured between 7 and 8 AM.

After typical jokes, complaints, stretching, coughing, teeth brushing, etc., by the group the shelter manager would address them briefly upon what to expect in the way of discomforts, give reassurance, outline some of the day's events, and mention some of the duties and responsibilities as well as the "happy" events that everyone might anticipate. It was noted that direction, although usually brief, was given every two hours or so throughout the day. This assumption of an imaginary pedestal by the shelter manager for a variety of purposes became a habitual act with automatic responsive attentiveness by the group. The shelter manager, in other words, became a human bulletin board, a newspaper, a forecaster, a religious leader, etc.

The completion of diaries was followed by breakfast. Two women distributed biscuits and recorded the number received by each shelteree. The water was siphoned from the water drum into an empty biscuit container. A drinking cup was used as a ladle and each shelteree helped himself and made a notation upon the

consumption record for each cupful of water.

After breakfast a "schoolroom" was set up for the children with biscuit cartons as desks. Several of the women seemed to enjoy their role as teachers in assisting the children with their study. Meanwhile, the men would gather in another part of the room to converse or debate various topics of interest. The shelter manager occasionally would read to the men from the Bible or from a geography textbook.

A formal training session involving some aspect of civil defense or radiological warfare would follow later in the morning.

As the length of stay progressed, more shelterees displayed decreasing energy and the post-lunch rest period became a welcome relief and brief escape. Lights were dimmed and quiet was maintained for one or two hours.

Exercise periods were never strenuous except for the few young people who held contests for push-ups and gymnastics. The exercises were simple and easy to perform for everyone. Their main objectives were to relieve muscular tension and substitute for lack of normal work and play activity. All shelterees, including the elderly, took part in the exercises.

A favorite game was of a hand-clapping, number-calling nature calling for continual attention on the part of each participant. At times as many as fourteen shelterees engaged in this game.

Other absorbing activities included round-robin statements by individuals upon various topics such as personal history, first actions upon leaving the shelter, future plans, etc. Activities such as these were usually very time consuming since each person would spend at least several minutes talking to the group about his own affairs. The leader in nearly all activities of this variety was the manager.

Another method of activating various groups in the shelter was the preparation stage of some unusual event. Various groups would be called upon to pre-

sent some aspect of a show, circus, banquet, or ceremony. Often more time was devoted to preparation than to the event itself. Having invested the time and effort for preparation, all were obligated to be a good audience or suffer group rejection.

An example of such preparation was the religious service. A children's choir and an adult choir with separate leaders for each and separate rehearsals occupied about half of the shelter population. A special committee organized the service and hand-printed programs with wording for hymns. The speakers took great pains in preparing appropriate and convincing sermons with corollary Bible readings. Others helped to "create" the church setting with stage props of water barrels and biscuit containers for pulpit and pews while others decorated the background wall with symbols and green plants. When the time for the non-denominational service came, all participated wholeheartedly.

Dinner at 5 or 6 PM was followed by heightened conversation of various sub-groups, active play by children, and occasional singing. At times the shelter manager or some other shelteree would give a talk on some adventure. Other shelterees would perform by story-telling or elaboration of some hobby or particular interest.

Later in the evening the shelter manager would recap the day's events, compliment the group and individuals on their cooperative behavior, and attempt to forecast what physical and psychological reactions may be expected to occur. The shelter manager or some designated individual would then lead the group in prayer, reminding the group of God's presence in the shelter and his support of each individual in the shelter. The lights would then be dimmed and one shelteree would read from Robinson Crusoe for approximately a half hour. The shelter became very quiet and by 11 PM nearly every person was sleeping.

b. General Schedule of Daily Activities

The following general schedule of daily activities was followed by the SM:

8:00 AM - 12:00 Noon

Lights on
Preparation for the day (shelter and personal)
Food and water distribution
Diary completion (9:00 AM)
Exercise
Training session (30 min.)
Other activities: planning sessions, committee meetings, announcements, morale-building sessions, group gripe sessions, group games, study

12:00 Noon - 4:00 PM

Food and water distribution
Quiet games
Study (adjust lights to suit segmented activity needs)
Rest
Informal activity

4:00 PM - 8:00 PM

Food and water distribution
Exercise
Training session (30 min.)
Special recreational activities

8:00 PM - 12 Midnight

Food and water distribution
Vespers, group discussion
Singing
Diary completion (9:00 PM)
Shelter clean-up and preparation for sleep
Lights off

Special Sunday Activity Schedule

Generally follow week-day schedule, particularly with regard to food and water distribution, diary completion. Allow for some departure from regular weekly routine by substituting group discussion or the like for training sessions. Provide group worship service either in AM or PM, depending upon group alertness.

Encourage group interaction on an informal basis.

c. General Outline of Training Topics

A general outline of training sessions is given in Table 3.

d. Day by Day Summary

The following daily account is based on observer data and diary data.

Sat. 27 April

As the day's testing reached completion, individuals began shelter entrance and at 1630 the shelter was locked. The shelter manager (SM) assumed immediate command and there was no doubt that he had done so. Throughout the study he maintained tight control, tempered with individual contact and understanding. The discipline exercised contributed greatly to the morale of the group and the success of the study.

The early part of the evening was spent by the SM instructing the group in the use of shelter equipment and supplies. The group listened attentively and followed directions. Biscuits and water were dispensed at 1730. Shelteree #6 (10-year old boy) began to bother the other boys and girls, hitting or pushing them. He also asked many questions of the adults and appeared to be irritating the group as a whole with demands for attention.

Difficulty in maintaining siphon action on the water drum hose led to oral suction, a policy that was followed throughout the study despite outside requests that the prescribed procedure be followed.

Shelterees made a deck of cards. Crayons that SM had taken in with him were passed out to the children, who drew pictures on walls of the shelter. Several snapshots were taken by #12, the psychology student participating in the experiment, as prearranged. Diaries were written at 2010, after which the cardboard mats were distributed for sleeping purposes.

Table 3

General Outline of Training Topics
Experimental Study III

Day*	Topic
Sat. 27 Apr.	Orientation to Shelter Organization and Supplies (on entry) Initial Adjustment Problems to Shelter Living
Sun. 28 Apr.	Nuclear Warfare Church Service
Mon. 29 Apr.	Communications and Warning Systems Blast, Radiation, and Fallout (Part I)
Tues. 30 Apr.	Blast, Radiation, and Fallout (Parts II and III)
Wed. 1 May	Shelter Types and Structures (Parts I and II)
Thurs. 2 May	Shelter Survival Needs Shelter Organization
Fri. 3 May	Sanitation. Physical Hygiene, First Aid (Parts I and II)
Sat. 4 May	Social and Psychological Problems of Survival (Parts I and II)
Sun. 5 May	No training session
Mon. 6 May	Post-Shelter Rehabilitation (Parts I and II)
Tues. 7 May	Rural Civil Defense (Parts I and II)
Wed. 8 May	International Preparedness for War (Parts I and II)
Thurs. 9 May	Civilian Participation in Civil Defense (Parts I and II)

*Training session to be held twice daily

The SM ended the day with an impressive prayer service lasting several minutes, in which he spoke personally to God, asking His blessing on the group and help for enduring the shelter stay. Religious activities were a major part of the daily as well as the Sunday program, with grace before each meal and a vesper service before retiring in the evening.

The SM organized the shelterees into a sexually segregated group and assigned sleeping spaces. Lights were dimmed at 2106 and the SM announced there would be a 5-minute period for final conversation, after which silence was to be maintained until he gave the signal to arise in the morning. This decision was accepted by the group without question and maintained throughout the study.

Sun, 28 April

Shelterees arose at 0645 (observer time; shelterees had no time pieces), filled out morning diaries and breakfasted at 0800. Games from 0800-0900 were followed by a SM lecture on nuclear warfare. After lunch the lights were dimmed for an hour's rest period. In the afternoon the shelterees held an impressive church service, with Scriptural readings and hymns. Biscuit boxes served as an altar. A cross and ferns were sketched on the wall to simulate a church setting.

At 1530 the SM gave a lecture on nuclear weapons. Diaries were completed at 1710 and it was obvious the shelterees had misjudged the time. Their evening time estimate later indicated they were three hours ahead of actual time. After a clean-up session, the group retired at 2020.

Diary data indicated general body aches from the previous night's sleep, and headache complaints. Many shelterees wrote that the church service seemed to unite them in a closer bond than heretofore.

Shelteree #6 (10-year old boy) pestered the other children during the day. Two shelterees, #35 (48-year old woman) and #13 (29-year old woman), appeared listless and withdrawn. The nurse applied a damp bandage

to #35's forehead, and conversation indicated nausea reactions throughout the day. Shelterees #12 (27-year old man), #11 (23-year old woman), and #17 (24-year old nurse), emerged as leaders in recreational activities.

At one point during the day the SM attempted to rig a "clock" by measuring in seconds the drip of water from a hole in a water cup. This method proved unsatisfactory, however, and was abandoned.

A new method of water dispensing was initiated. The SM filled an empty biscuit can with water and shelterees scooped out their rations.

Mon, 29 April

At 0330 most shelterees awoke, thinking it was later than it was. SM told them to sleep for another hour, and everyone slept until 0700. Since the group was still several hours off actual time in their estimates, the correct time was sent in by note at 0745. This procedure was agreed upon previously in the experimental design for time perception evaluation.

Breakfast was followed by exercise and the administration of the Prelinger Self-Concept Test (a personality test). At 0935 a school session was held for the children, after which the group played cards and other games. A SM lecture at 1411 on fallout radiation was followed by the usual rest period. Later in the afternoon the group played charades, "I've Got a Secret," and conducted a talent show, led by #11 (23-year old woman) and #31 (12-year old girl).

(First defection 1900)

Shelteree #17 (24-year old nurse) was ill most of the day, and after a telephone conference with the SM, it was decided to release her from the shelter. The post-shelter interview indicated a possible pregnancy, later verified (see Defections). The SM gave a pep talk to the group after #17's exit. Shelteree #29 (45-year old practical nurse) took over the nursing duties.

At 1940 the SM sealed off the first commode.

A group sing at 2140 was led by #12 (psychology graduate student) and #21 (46-year old woman). At 2215 shelteree #12 read parts of Robinson Crusoe to the group, from one of the children's school books. At 2305 the shelterees retired.

Tues. 30 April

Rising at 0645, the shelterees breakfasted and SM initiated the day's activities. The usual routine of lectures, exercise, games, rest after lunch, clean-up, diaries, and evening prayer was implemented. A free-drawing test was administered by #12 (psychology graduate student), and the group planned a "May Day" celebration for the next day. A square dance in the afternoon was well received.

Salt was used in the biscuits to neutralize the sweet taste, according to the diaries. Headaches and nausea continued.

An "occupied - vacancy" sign was made for the latrine door.

Shelterees retired at 2215.

Wed. 1 May

Shelterees arose at 0700. The day's activities included a lecture on Civil Defense Communications by #18 (back-up SM, 35-year old man), a limbo contest, human pyramid building, autobiographical narratives, and a "May Day" celebration. Shelteree #31 (12-year old girl) was selected "Queen of the Shelter," and she in turn chose the SM for "King." Shelteree #11 (23-year old woman) organized the May Day festivities.

The SM had used a single water liner to the converted water drum commode, and the second liner was used at one time as covering for sleep, and then later cut into strips for the May Pole dance.

Diaries indicated growing awareness of body odor. Shelteree #6 (10-year old boy) was reported by several of the group as being very homesick.

The group retired at 2140.

Thurs, 2 May

Shelterees did not arise until 0830. Exercise, clean-up, and school session for children occupied most of the morning. A noon lecture on Georgia history by #16 (34-year old man) was apathetically received. Games such as "air, fire, earth, and water," "hot potato," and a group sing led by #11 and #19 (41-year old woman) were afternoon events. Shelteree #6 withdrew from group activities throughout the day. He requested to be removed and at 1500 was released from the shelter. Diaries indicated he had antagonized most of the shelterees and they did not sympathize with his homesickness.

(Second defection 1500)

The prominent event of the day was a "Womanless Wedding" at 1800. The SM was the bride and #18 the groom. Other participants were #26, the bride's mother, #9, the flower girl, #12, the preacher, #8, the rejected suitor, #4, the maid of honor, #16, father of the bride, and #2, the best man. It was a "shotgun" wedding tableau.

An evening lecture at 2010 on family fallout shelter preparation by the SM was followed at 2145 by a Robinson Crusoe reading on the part of #15 (30-year old woman). The group retired at 2240.

The second chemical commode was sealed off at 1000. Diaries indicated that both first and second commodes smelled bad. Water dispensing by "dipping" into the biscuit can was continued. Checkerboards were drawn on the cardboard mats for recreational use.

Fri, 3 May

In the early morning, 0615, the SM requested via shelter telephone that room temperature be lowered. At 0830 shelterees arose. A urine collection was made at 1010; the written instructions were read avidly and passed around by the group, apparently a substitute for the need for news from the outside world. A school session for the children from 1100 - 1200 was followed by a SM lecture on blast and fallout protection. This lecture, as well as previous ones, was

favorably received. An afternoon discussion of rural Civil Defense problems, led by #26 (57-year old man) evoked much interest. Other afternoon events included a sentence-completion test and a talent show. The evening's highlight was a circus, including a two-headed lady, a bearded lady, and clowns, ingeniously contrived. The group appeared to be in high spirits when they retired at 2145.

Sat, 4 May

After awaking at 0800, shelterees breakfasted, cleaned up, and began the day's activities. A radioactivity lecture and first-aid talk were given at 1100 by the SM and #18. In the afternoon a two-hour bingo game was played, using cards made from the cardboard mats. Tobacco supplies began to be depleted. Other complaints centered on odor, constipation, and first bowel movements by many shelterees since entry. Depression set in during the day, and seemed to reach the lowest point during the study at this time.

The group retired at 2100.

Sun, 5 May

Shelterees arose at 0907. The usual morning routine was followed, the lecture given on Civil Defense research. Close-order drill was used by SM for the afternoon exercise. A sponge bath with handkerchiefs was welcomed by the group. Plans for church service were delayed and the service was not conducted until 2050. The SM seemed to reach his lowest efficiency level on this day. The general group depression appeared to be lifting. A group sing at 2100 was followed by bedtime at 2250.

The third commode was sealed off at 1615.

Mon, 6 May

Shelterees arose late at 0945. The day's activities included a school session, lectures on radiation and fallout shelters, and games such as cards, Twenty Questions, Kitty Cat, Rhythm, Hokey Pokey, and story telling.

Shelteree #18 complained of swollen gums but wished to endure the study. The SM telephoned the watch at 1750 and requested a physical check on #18. It was agreed that a physician should see him the next morning. The SM also requested additional drinking cups to replace those damaged, but this request was refused.

The group retired at 2137.

Tues. 7 May

Early in the morning, 0355, SM telephoned watch to complain of cold; room temperature was raised accordingly. At 0805 the group awakened. The consulting physician examined #18 at 0905 and judged the gum condition not to be of a serious nature. Shelteree #18 elected to return to the shelter rather than leave.

Lectures during the day centered on shelter stocking and the psychological aspects of nuclear war.

The group appeared to be apathetic and depressed most of the day. Diaries indicated they were looking forward to release on Friday.

At 2100 the SM sealed off the fourth commode.

Wed. 8 May

At 0852 shelterees awakened. The Prelinger Self-Concept Test was administered in the morning. An afternoon lecture on first-aid was given by #29 and #15. The high point of the day was an elaborate "divorce trial." a follow-up on the "wedding" held the previous week. The trial, lasting an hour, involved plantiff and defendant, clerk of court, sheriff, attorneys, and witnesses. The affair was enjoyed by all.

Group spirits seemed to follow a pattern of depression on first arising in the morning, then gradually alleviating to good humor at the end of the day.

The shelterees retired at 2200, after a session of reading Robinson Crusoe, then a period of soft group singing, and an evening prayer.

Thurs. 9 May

The day began at 0715. A urine collection was taken at 0940. At 1015 the Post-Shelter Questionnaire was administered, and in the afternoon a Sentence Completion Test. An evening lecture at 1930 centered on post-shelter rehabilitation.

The significant event of the day was a Farewell Banquet held at 1640. There were songs, testimonials, and party decorations. Plastic water drum liners served as tablecloths. Placemats were made from cardboard, and each setting was ornamented with paper flowers. Spirits were high, with mixed emotions. A few shelterees cried as Auld Lang Syne was sung. Others exchanged home addresses and made plans for reunion. All felt proud of their shelter endurance and completion of the study. Some of the diaries expressed gratitude at the opportunity of participating in the experiment.

At 2015 the group settled down for the night.

Fri. 10 May

In early morning, 0255, the SM's request for temperature to be raised was granted. The group awoke at 0600. After breakfast, the shelter was cleaned up and shelterees prepared to leave. After instructions by the Project Director over the intercom, the group exited at 0835, and began the day's post-shelter testing.

3. Defections

The study was highly successful in that only two out of thirty shelterees defected. The first, shelteree #17, the 24-year old nurse, exited at 1900 on Monday, 29 April, because of continuous nausea. The post-shelter interview and medical examination indicated a pregnancy which she had successfully concealed from both her husband and personal physician. She thought she would be able to participate in the study without mishap, and was very saddened and apologetic over defection.

The second defection, shelteree #16, a 10-year o

boy, occurred at 1500 on Thursday, 2 May. The primary reason, ascertained from observer reports and diaries of other shelterees, was inability to adjust socially to other shelterees and the shelter conditions.

4. In-Shelter Medical History

An abbreviated medical kit was used in Experimental Study III, composed of reduced quantities of items contained in OCD Medical Kit A. Rationale for the items included was based upon the fact that these were the items used in Experimental Group II. Phenobarbital was the only excluded medication that was used in the previous two-week study.

Complaints were recorded, diagnosed, and treated by the registered nurse and after her exit by a back-up practical nurse (#29). Complaints were generally of a simple nature and easily handled with aspirin, bicarbonate, or salt. 9

Medical complaints and treatment were recorded on a standard form and passed out daily with diary forms. Incidence of complaints decreased from a total of twenty on the first day to five on the last day. Headaches comprised the chief source of complaints, with nausea and colds accounting for most of the remainder. The number of individuals complaining decreased from a total of thirteen on the first day to four on the last day. The majority of individuals made few or no complaints throughout the occupancy.

The only case for a possible withdrawal due to medical reasons other than the two early exit shelterees was shelteree #18 (35-year old man). On Wednesday evening, 6 May, the shelter manager called out to report that this man, suffering from swollen gums, was very concerned about his condition. However, he did not wish to leave if his condition was not serious. It was then arranged to have the consulting physician examine his gums the following morning with the stipulation that the shelteree be allowed to return to the shelter if his condition was judged to be mild.

The physician examined #18 at approximately 0900 the

following morning and diagnosed the swollen gums as "a small area of simple gingivitis." It was recommended that the subject return to the shelter if desired with instructions to report any increase in symptoms or new symptoms. The shelteree was obviously relieved, and returned to the shelter with no further complaints during the remainder of his stay.

5. Shelteree Reactions

Attitudes and reactions of shelterees were evaluated several ways: (1) a Shelter Entrance Questionnaire completed prior to entrance, (2) an unstructured shelter diary sheet filled out twice daily, and (3) a Post-Shelter Questionnaire administered the day prior to shelter exit.

a. Shelter Entrance Questionnaire

As in previous experimental studies, participants in Experimental Study III completed a Shelter Entrance Questionnaire designed to elicit their reasons for taking part in the research, their preparedness for emergency survival, the source and content of their knowledge about the research, their prior acquaintance with other shelterees in the study, and their anticipations of stress to be incurred by the confinement experience.

Primary motivation for participation centered on concern to enhance knowledge of survival, and a desire to assist the national defense effort. Preparedness, however, was lacking, e.g., seventy per cent of the group did not know the whereabouts of the nearest public fallout shelter.

Factors anticipated to be stressful by at least half the group were sleep conditions and bathing facilities.

b. Shelter Diaries

As in Experimental Study II, the number of complaints mentioned in the diaries tapered off as confinement continued. Possible explanations are adaptation to stress and the feeling that once a complaint was mentioned, repetition was unnecessary.

Diary complaint factors were more precisely delineated on the Post-Shelter Questionnaire, discussed in section III. A. 5. d. of this report.

c. Shelter Manager Report

The following account was written by the SM approximately one week following exit from the shelter:

"Knowledge of the implementation of and value received from properly administered discipline was of extreme importance to me in the management of affairs in the shelter. Strict military discipline is not good with a civilian group. However, if there is a choice to be made between strict discipline and little or no discipline, one should tend toward the administration of strict discipline. One can always slack off, but to tighten up on discipline once it has been lax is next to impossible.

Very little of my training as SM was of a formal nature. In fact, about the only phase that could be considered formal was my instruction in the use of the equipment in the shelter, methods for reporting information, filling out diaries, etc. However, I did spend about a total of eight hours in conversation with various members of the staff and it was during these talks that I was able to pick up fragments of information, much of which proved to be invaluable to me as the SM. The following is a listing of the various bits of information that were of real significance.

1. Space: Finding space for all to sleep will be a problem, and in the past studies various sleeping arrangements had been tried. The best sleeping arrangement when individuals of both sexes are in the same room is to have the men sleep in one section and women in the other with the young people interspersed in the available space.

2. Variations in temperature: When sleeping, a temperature that is comfortable for one person will not necessarily be a comfortable temperature for another. During the stay in the shelter, this was a constant problem and one which I feel we were only partially successful in solving. However, knowing that this

would be a problem, I was constantly aware that we must make every attempt to equate these variances in sensitivity. At the conclusion of the shelter stay it was the consensus of opinion that if blankets had been available, a good deal of this problem would have been solved. I also feel that whenever feasible, the Ss should wear as much heavy clothing as possible. It is very easy to shed clothing when it gets too warm, but it is impossible to wear more if you do not have any with you. Some of the women, I feel, were very much underdressed in that they did not have a sweater or some other similar article of heavy clothing.

3. Odors: After awhile one's own body odor will become quite apparent and some people will become overly concerned about this. Realizing that this situation would eventually occur, I was prepared to inform the group that this should cause no one any real concern.

4. Constipation: Since the Ss will be on a bland, low calorie diet, the need to defecate will be greatly reduced. The knowledge that this situation would occur and that there was no real cause for alarm if bowel habits were temporarily halted or reduced, helped me to allay the fears of many who were at first concerned.

5. Cardboard Sheets: In the past the Ss used these as floormats, drew checker boards on them, and some even had tried to use them as covers.

6. Drinking Water: The dispensing of water had proved to be a problem to the past groups; at least it was a problem if dispensed according to the prescribed methods. We, too, found that dispensing the water as prescribed was a problem, but we were able to come up with a solution very quickly because I had thought about what I would do if our group also had trouble.

7. Lectures: For the most part the Ss were interested. The length of the lectures could be somewhat longer than under normal conditions. This fact I found to be true and I was therefore able to present almost all the material planned for the lectures to the group. The lectures also kept the Ss thinking

about things other than themselves.

8. Critical Periods in Shelter Adjustment: The second, fourth, seventh and tenth days were the critical ones. Some of the things which would bother persons at one time would, as time progressed, bother them less, and a new irritant would take its place. I did not know exactly what to expect concerning this matter, but I was at least aware that I should be looking for various signs, which if not corrected might have a detrimental affect on group morale. What the SM does and says has great influence on the Ss. I was ever cognizant that I must be very careful not to make adverse comments on anything that might be an irritant factor, for by doing so would only tend to intensify the factor. As an example of this, the very first day I was having real difficulty in getting any of the Ss to drink the water. Many disliked the taste of the iodine; in fact, some refused to drink any, and many of those who drank felt nauseated. I felt at this time there were many who could not taste very much iodine in the water, but if some noticed it, they could not be the ones in the group to say that they did not notice anything. I decided that when we opened the second container of water that I, along with a couple of picked persons, was going to be the first to sample the new water. Although to me personally it did not taste any different, I made sure that all knew I considered this new water to taste far superior to that of the previous container, and I asked those whom I had picked if they did not also feel the same. As I expected, they too noticed a great difference in taste. It was not long thereafter that everyone wanted to sample the new water. It did taste good and from then on I had no real problem in getting the people to drink it.

9. Daily Routine: Some type of routine should be established. Although I did not formulate a definite plan for a daily routine before I entered the shelter, I was aware that a planned routine was necessary, and one of the things that I took with me into the shelter was a sheet with a suggested timed routine. I found that using this routine as a guideline helped me to formulate a schedule which was for the most part flexible and responsive to the moods of the Ss.

10. Squatter's Rights: Prior to entry I was told that it would not take long before some of the Ss would establish themselves in a particular spot and beware to the person who violated his space. It was also pointed out that some persons, once they find their place, rarely move from that spot. Knowing that this was going to take place and that it was best to keep the people active, we were able to fabricate a plan that accomplished this without the individual knowing that he was being moved. Playing games and shifting furniture will accomplish this objective.

The Shelter Manager should be alert and responsive to the needs of the Ss and therefore should alter the schedule whenever it will serve the best interests of the entire group. The SM must be the boss with respect to changes in the daily routine; he will not be able to please everybody all the time. Keep the group active, make them move about, keep them thinking, but not about themselves. Plan some special events well in advance so that the group will have things to look forward to.

It might be well to note that during this shelter study no time pieces were used. In our present day society many of our actions seem to be geared to the clock, and when the clock fails or is not correct, we often experience difficulty in making the adjustment. When I first learned that we would not be taking any watches into the shelter I was somewhat worried. How could I schedule the various activities? Would the whole shelter program turn into chaos? Contrary to my initial beliefs, I feel that after spending two weeks in the shelter without the knowledge of the exact time, I was better off for having done so. By not knowing the exact time I tried to gage how long we should spend on a specific activity by studying the group, and thus I feel I was more acutely cognizant of how they felt. I also found that the human biological system will set its own time signals, which for the most part have been geared to the pattern of living that the individual established prior to entering the shelter. I feel that many persons were better off for not knowing the time. When one does not watch the clock, time usually passes much more rapidly--this is an important aspect in shelter living."

d. Post-Shelter Questionnaire

The afternoon of the day prior to exit from the shelter, the twenty-eight remaining shelterees completed a Post-Shelter Questionnaire designed to determine and evaluate various discomfort incurred by confinement, to assay general adaptation to and tolerance for shelter living, to elicit sociometric choices along several dimensions, and to ascertain shelteree reactions to shelter supplies and procedures. This form was also filled out by the ten-year old male (#6) who exited on the fifth day of confinement; hence analysis focuses on data provided by twenty-nine of the original thirty-person group. The earliest defector, the shelter nurse (#17), did not complete the form due to the relatively brief time she endured confinement.

Discomfort factors mentioned by at least one-half of the shelterees are listed in Table 4, in terms of number of shelterees complaining, and also in terms of relative mean ranking. Chief complaints were lack of bathing facilities, sleep conditions, odors, chemical toilet, and uncomfortable temperature. Food was next on the list, and although mentioned by less than half the group, or twelve shelterees, was ranked first by them.

The complaint factors in Experimental Group III closely approximated those of Experimental Study II. However, tolerance of confinement appeared to be stronger in Experimental Study III. In contrast to Experimental Group II's tolerance estimate of 11.4 days further confinement, the shelterees of Experimental Study III estimate their tolerance of continued confinement to be 20.9 days beyond the two weeks already spent in the shelter. The mean male estimate was 3.1 additional days, the female mean estimate was 7.9 additional days, and the children (aged 7-12) estimated 16.0 days.

Shelterees in Experimental Study III appeared to achieve a relatively better adjustment than those of earlier studies. The morale and cohesiveness of the group, under the capable leadership of the SM, was noteworthy.

Table 4

Selection and Ranking of Major Discomfort Items
(by 50% or More Shelterees in Experimental Study III)

Item	Rank on Basis of N	N	Item	Rank of Basis of Mean Evaluation	Mean
Lack of bathing facilities	1	18	Sleep conditions	1	2.50
Sleep conditions	2	16	Lack of bathing facilities	2	3.00
Odors	3	15	Chemical toilet	3.5	3.07
Chemical toilet	4.5	14	Uncomfortable temperature	3.5	3.07
Uncomfortable temperature	4.5	14	Odors	5	3.33

e. Sociometric Analysis

The two shelterees selected as the most desirable future shelter companions were #14 (the SM) and #11 (23-year old female). The two individuals rejected as undesirable future shelter companions were #6 (the 10-year old boy who defected) and #22 (61-year old man). When asked to choose two individuals that might make a good future SM, the group selected shelteree #18 (35-year old man) and #16 (34-year old man).

f. Time Perception

Prior to shelter entry, all pocket and wrist watches were taken from the shelterees. There was consequently no mechanical means of recording the passage of time. Furthermore, environmental cues such as night and day were removed by shelter confinement conditions.

Time judgments were made by each shelteree on morning and evening diary forms. The shelter manager pressed a buzzer in the morning at approximately 0900 and in the evening at approximately 2100. Each shelteree then wrote his time judgment on the diary form. On hearing the buzzer signal, the outside staff observers recorded the actual time. For administrative purposes it was decided to send in the correct time if the mean time estimate deviated $\pm$ three hours from actual time. Only the shelter manager was informed of this procedure.

On two occasions during the occupancy the shelterees did receive feedback concerning actual time. On the second morning the correct time was sent to the shelter manager, since the three hour limit had been exceeded. Seven days later one shelteree left the shelter for ten minutes to be examined by the consulting physician.

The daily morning and evening mean deviations are presented in Figure 1. The shelterees underestimated morning time with a mean deviation of 49 minutes, and overestimated evening time with a mean of 117

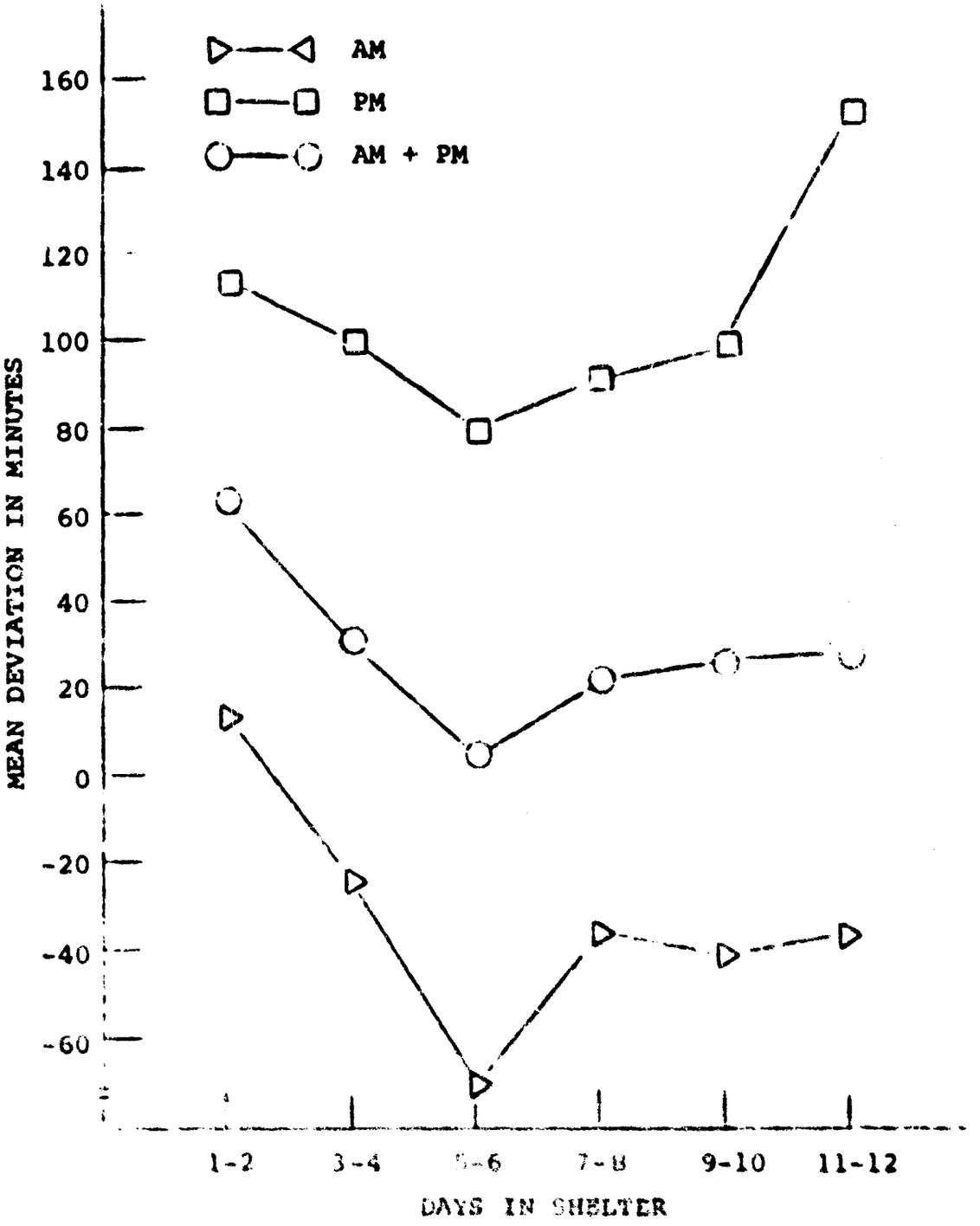

Figure 1--Time Estimate Error (Experimental Study III)

minutes. For example, shelterees arose at a later hour than the actual hour, and retired at an earlier hour than the actual hour.

Lack of time pieces was considered a discomfort by only four of the twenty-eight remaining shelterees on the Post-Shelter Questionnaire (#'s 2, 8, 9, and 18). Behavioral cycles were apparently unaffected by the lack of knowledge of time. Further analysis of time perception data is in progress.

6. Observational Data

Activity patterns such as sleeping, exercise, eating, sitting, standing, recreation, etc., closely followed the patterns of Experimental Study II and are not presented here.

In terms of social interaction, observers ranked the following shelterees as most dominant in group leadership and participation: 14, 12, 15, 11, and 18. Shelterees ranked as socially withdrawn were: 20, 21, 22, 12, and 23.

7. Environmental Data

a. Temperature and Humidity

The mean daily effective temperature (ET) over the confinement is portrayed in Figure 2. The initial ET was 75° at time of entry, and remained fairly stable over the first nine days, at which point the Ss requested more warmth, resulting in a consequent rise in ET toward the end of the study. The need for the higher ET was presumably an effect of sleeping on the floor and living on a low calorie diet.

11

12

b. Activity and Noise Levels

Activity and noise levels were closely correlated. Furthermore, these variations in Experimental Study III closely approximated the findings in Experimental Study II (Figure 3). Computed correlations between noise level and activity level and between Experimental Study

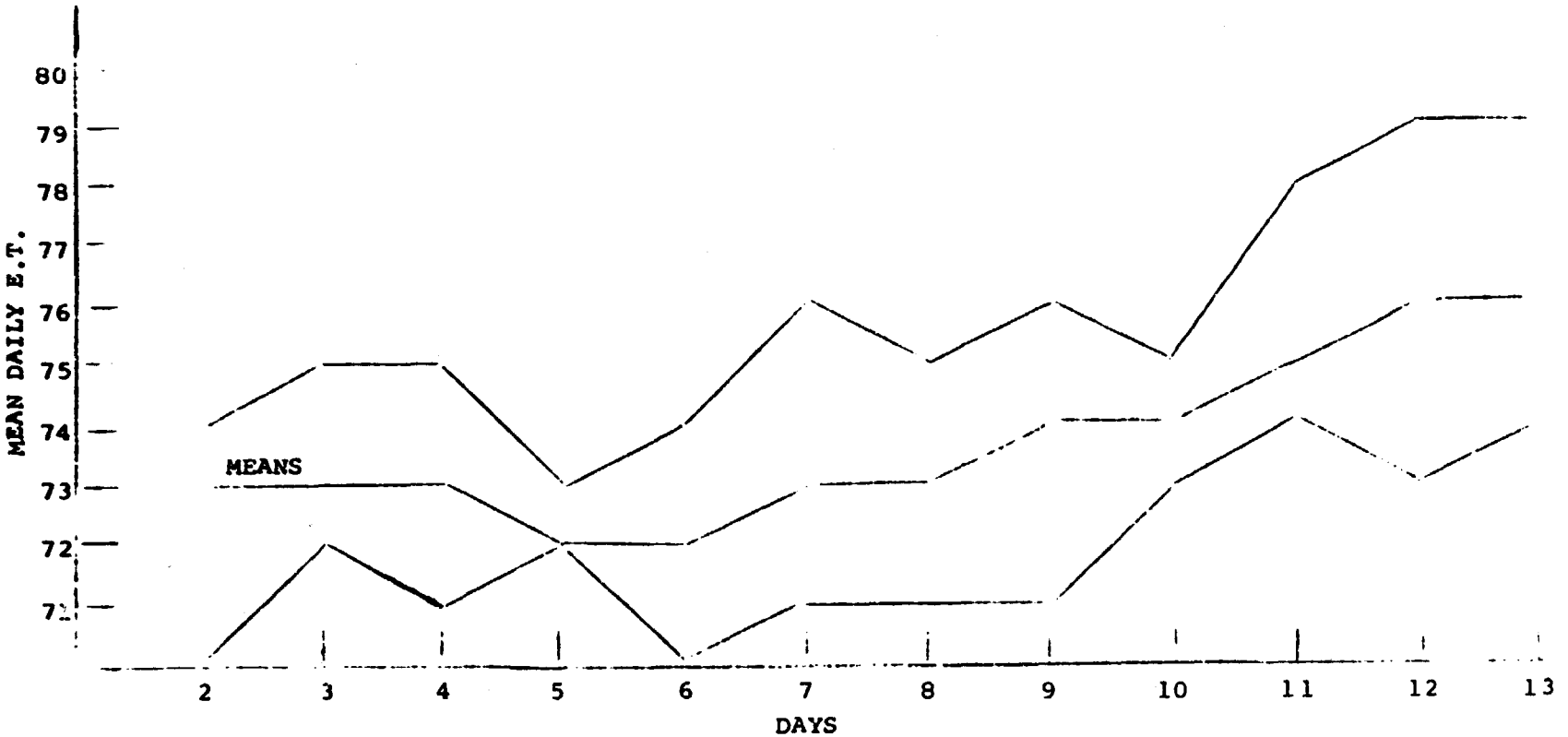

Figure 2--Daily Means and Ranges of Effective Temperature
(Experimental Study III)

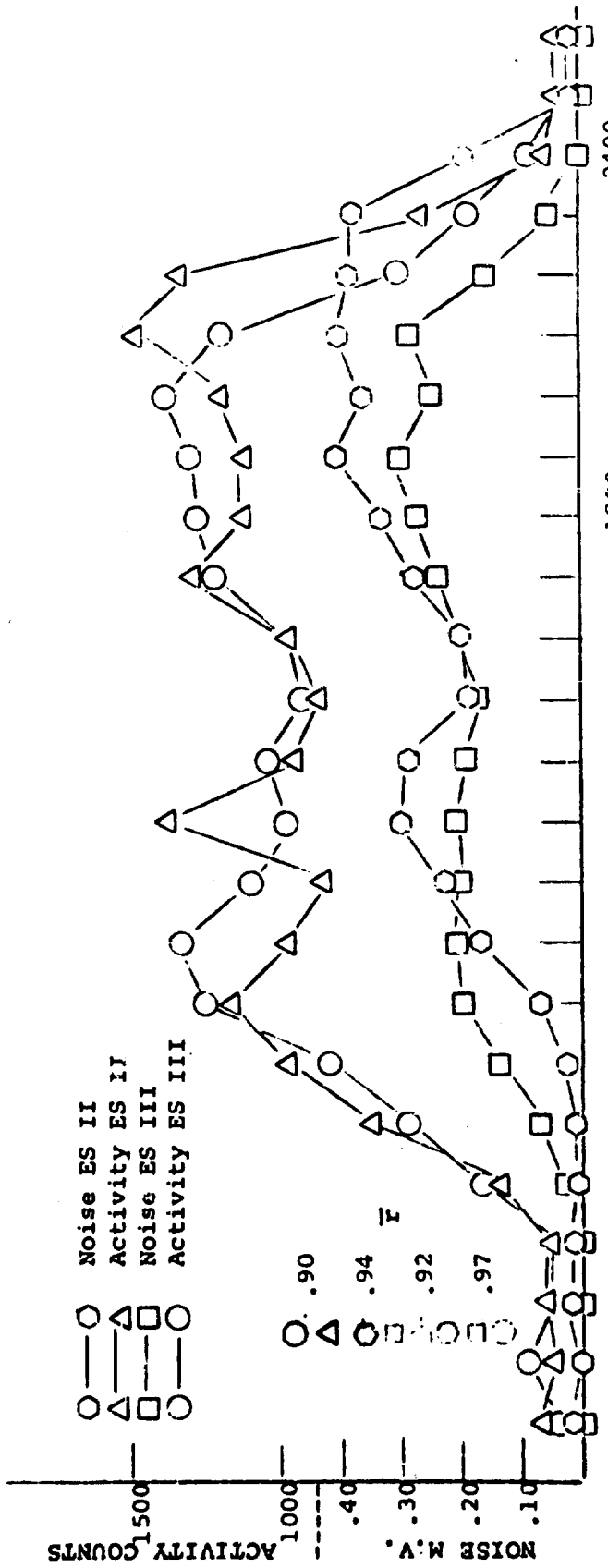

Figure 3--Hourly Activity and Noise Levels Averaged over Total Confinement (Experimental Studies II and III)

II and III, were all above .90.

8. Commode Chemical Tests

A series of commode tests was initiated in Experimental Study III. These are outlined in Table 5. Since urine collection in the previous study, Experimental Study II, depleted the normal liquid contents of the commode and may have confounded the odor problem, the first commode test in Experimental Study III was Weladyne as prescribed. Also, when the mid-study urine collection was taken, water in equal amount was deposited in the commode to compensate for this factor.

Commode test four was conducted at the request of the SM, who thought that possibly the presence of tissue paper created a flotation problem and diminished the odor neutralization of the Weladyne.

Shelteree reactions indicated that odor was a problem in all tests but number five, in which sodium nitrate was added to the Weladyne. This test proved satisfactory in removing odor as a complaint.

The sixth and seventh commode chemical tests will be conducted in Experimental Study IV.

9. Supplies Evaluation

Questions on the Post-Shelter Questionnaire evaluating the adequacy of supplies evoked a wide range of comment. In summary, the primary suggested additional item was blankets, mentioned by 14 shelteree. Items suggested by at least three shelterees included pillows, greater variety of food, and additional recreational materials.

Complaints regarding the shelter conditions centered on the commode chemical, fragility of the water cups, uncleanliness of self and shelter area, sleeping conditions, and lack of variety of food.

B. Pre- and Post-Shelter Test Results

1. Medical Examination

Table 5

Commode Chemical Tests Initiated in Experimental Study III

Test	Commode Volume	Amount of Water	Commode Chemical
No. 1	0	None	2-2/3 Oz. Weladyne
No. 2	0	To cover contents	2-2/3 Oz. Weladyne
No. 3	0	1 Qt.	2-2/3 Oz. Weladyne
	1/3 Full	0	" " "
	2/3 Full	0	" " "
No. 4	Same as No. 1, with toilet tissue placed in separate container		
No. 5	0	1 Qt.	2-2/3 Oz. Weladyne; 0.5 Oz. Sod. Nitrate
	1/3 Full	0	" " " " " " "
	2/3 Full	0	" " " " " " "
No. 6[a]	0	1 Qt.	2 Oz. Boric Acid; 1 Oz. Sod. Perborate; 1 Pt. Mineral Oil
	1/2 Full	0	1 Oz. " " 0.5 Oz. " " 0. Pt. " "
	3/4 Full	0	1 Oz. " " 0.5 Oz. " " 0.5 Pt. " "
No. 7[a]	0	2 Qts.	1.0 Oz. Cupric Sulphate; 4 Oz. Sod. Perborate; 0.5 Pt. Mineral Oil
	1/2 Full	0	0.5 Oz. " " 3 Oz. " " 0.5 Pt. " "
	3/4 Full	0	0.5 Oz. " " 3 Oz. " " 0.5 Pt. " "

[a]Conducted in Experimental Study IV

Post-shelter medical examinations indicated no deleterious effects from shelter confinement. A natural weight loss occurred, 7.6 pounds for males, 4.6 pounds for females. Weight recovery was for practical purposes complete within two weeks of study completion. Weight recovery was slower for females than for males. Since many female shelterees expressed satisfaction over their weight loss, they may have been consequently reluctant to return to their former weight status. 16

2. Physical Fitness Testing

Psychomotor performance showed a slight improvement, probably because of practice effect rather than enhancement by the shelter stay. There were no significant changes in tests of physical strength or endurance.

3. Psychological Testing

As in Experimental Study II, the shelterees experienced no significant psychological changes as a result of the stress variables under investigation in the present study.

IV. Conclusions

A synthesis of the conclusions from all experimental studies will be presented in the Final Report. The following conclusions are indicated by Experimental Study III:

A. General Conclusions

1. Healthy men, women, and children, aged 7-66, can subsist for two weeks under crowded conditions on water rations of 1 qt./person/day, survival biscuits of 814 cal./person/day, and sleep on a concrete floor covered only with thin cardboard, without suffering deleterious physiological or psychological effects. Shelterees' estimate of an extended stay was 21 days.

B. Specific Observations

1. Shelter Environment

a. Limited living space of 8 sq. ft./person and 1 cu. ft./person additional storage is tolerable.

b. In terms of survival, cardboard is a satisfactory substitute for bunks as a sleeping surface.

c. Water dispensing method needs improvement, e.g., a hose clip to maintain siphon action.

2. Shelteree Reactions

a. Only two defections occurred during the study, one for reasons of health and the other because of inability to achieve social adjustment.

b. Average estimates of endurance of extended shelter stay for men, women, and children were 33, 8, and 16 days respectively.

c. Weight loss averaged 6.1 pounds (7.6 pounds for males, 4.6 pounds for females).

d. Weight loss was practically fully recovered within two weeks of study completion.

e. Primary environmental complaints were: lack of bathing facilities, sleep conditions, odors, chemical toilet, and uncomfortable temperature.

f. Primary physiological complaints were: headaches, nausea, and colds, all of which diminished as complaints toward the end of the study.

g. During the study, the effective temperature was gradually increased in accordance with shelteree request.

h. Circadian patterns of activity showed high consistency throughout the study.

i. Lack of knowledge of time need not be a disrupting factor in the daily routine of shelter life.

j. A disciplined shelter organization is conducive to high morale and successful in-shelter adjustment.

k. Shelteree preparedness, in terms of knowledge of Civil Defense information, was grossly inadequate.

V. Forecast

Experimental Study IV, a one-week occupancy test using children aged 7-12, was conducted 20-27 July, 1963. Variables evaluated in this study are given in Table 6. Data analysis of this study is in progress and will be submitted as a special interim report when completed.

Table 6

Variables to be Evaluated in Experimental Study IV
(20 July - 27 July, 1963)

Shelteree Characteristics

Number - Twenty-eight (28) children, one shelter manager, and one medical aide
Age - 7 to 12
Sex - 15 males, 15 females

Shelter Environment

Space - 6 sq. ft./person (39 cu. ft./person)
- 1 cu. ft./person storage additional
Temperature - optimal
Humidity - optimal
Ventilation - 40 cfm/person during day and 15 cfm/person during the night. Ratio of fresh air to recirculated air is 1:4.

Shelter Supplies

Water - 1½ quarts/person/day
Food - 600 calories/person/day (Nebraska wheat-corn-flour cracker)
- 300 calories/person/day OCD Carbohydrate Supplement Food
Sanitation - OCD Sanitation Kit III
Medication - items from OCD Medical Kit A
Bunks - none; will sleep on cardboard placed on floor
Blankets - none
Recreational materials - none
Washing water - none

NOTES:

1. An inshelter nurse will be provided in Experimental Study IV. In addition, a standby physician will be on 24-hour call, as in previous studies. All shelterees will receive physical examinations before and after shelter confinement.

2. The Bulgur wheat wafer was used in Experimental Study II and the Nabisco wheat-flour biscuit in Experimental Study III. The Nebraska wheat-corn-flour cracker will be tested in Experimental Study IV.

3. The 3/16-inch corrugated cardboard pallets used in the previou two studies will again be used in Experimental Study IV, and, as in Study III, in quantities sufficient to cover the floor.

4. Commode chemical tests initiated in Experimental Study III will be continued in Experimental Study IV.

5. Space allotted in Experimental Study III was 8 sq. ft./person, exclusive of storage. In Experimental Study IV, space will be reduced to 6 sq. ft./person, exclusive of storage.

6. A daily 300-calorie ration of OCD Carbohydrate Supplement Food will be added to the food rations of Experimental Study IV. This candy ration, plus 600 calories/day of the cracker, will give a total daily ratior per person of 900 calories.

Appendix F

Experimental Study IV

Table of Contents

Abstract

From July 20 - 27, 1963, the University of Georgia Psychological Laboratories conducted a one-week simulated fallout shelter occupancy study with a group of elementary school children under austere conditions. Twenty-eight children, aged 7-12 and two adults participated in the experiment. Stress conditions included restricted food and water rations, minimal living space (6 sq. ft./person), chemical commodes, absence of furniture and bedding, and minimal recreational supplies (pencils and paper). Water intake averaged 1.0 qt./person/day and food consumption averaged 848 calories/person/day.

Eleven children and one adult voluntarily left the shelter prior to scheduled exit. The remaining shelterees emerged in good physiological and psychological condition.

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List of Figures

I. Introduction

Previous shelter occupancy studies at the Psychological Laboratories, University of Georgia, have established the habitability of a simulated shelter under austere conditions for two-week periods. The present report describes Experimental Study IV, a one-week occupancy (July 20-27, 1963) by a group of 28 elementary school children and two adults.

II. Experimental Design

A. Purpose

Experimental Study IV was designed to test shelter occupancy by children under conditions listed in Table 1. These conditions are similar to those of former two-week occupancy studies (Experimental Studies II and III). The available floor space was reduced to six square feet/person in the present study. The shelteree characteristics differ primarily in age. No books or recreational material other than paper and pencils were supplied or taken into the shelter.

B. Selection of Subjects

The 28 children who participated in Experimental Study IV were randomly selected from a pool of 95 elementary school age applicants which had been stratified by age and sex. There were 14 boys and 14 girls ranging in age from 7 through 12. Age and educational level of the shelterees are presented in Table 2.

The shelter manager (SM) and the shelter nurse (SN) were specifically selected and trained for their assignments. Both the principal and alternate SMs were elementary school principals in their mid-thirties. The SN was a 29-year old Public Health Nurse.

C. Pre- and Post-Shelter Testing Procedures

1. Medical Examination

Prior to the beginning of the study each shelteree was given a complete medical examination by his family

Table 1

Variables Evaluated in Experimental Study IV
(20 July - 27 July, 1963)

Shelteree Characteristics

Number - Twenty-eight (28) children, one shelter manager, and one medical aide
Age - 7 through 12
Sex - 13 males, 15 females

Shelter Environment

Space - 6 sq. ft./person (39 cu. ft./person)
- 1 cu. ft./person storage additional
Temperature - optimal
Humidity - optimal
Ventilation - 40 cfm/person during day and 15 cfm/person during the night. Ratio of fresh air to recirculated air was 1:4.

Shelter Supplies

Water - 1½ quarts/person/day
Food - 600 calories/person/day (Nebraska wheat-corn-flour cracker)
- 300 calories/person/day OCD Carbohydrate Supplement Food
Sanitation - OCD Sanitation Kit III
Medication - items from OCD Medical Kit A
Bunks - none; cardboard placed on floor
Blankets - none
Recreational materials - none
Washing water - none

Notes:

1. An in-shelter nurse was provided in Experimental Study IV. In addition, a standby physician was on 24-hour call, as in previous studies. All shelterees received physical examinations before and after shelter confinement.

Table 1
(Cont'd)

2. The bulgur wheat wafer was used in Experimental Study II and the Nabisco wheat-flour biscuit in Experimental Study III. The Nebraska wheat-corn-flour cracker was tested in Experimental Study IV.

3. The 3/16-inch corrugated cardboard pallets used in the previous two studies were again used in Experimental Study IV, and, as in study III, in quantities sufficient to cover the floor.

4. Commode chemical tests initiated in Experimental Study III were continued in Experimental Study IV.

5. Space allotted in Experimental Study III was 8 sq. ft./person, exclusive of storage. In Experimental Study IV, space was reduced to 6 sq. ft./person, exclusive of storage.

6. A daily 300-calorie ration of OCD Carbohydrate Supplement Food was added to the food rations of Experimental Study IV. This candy ration, plus 600 calories/day of the cracker, gave a total daily ration per person of 900 calories.

Table 2

Age, Educational Level, and IQ of Shelterees

Number	Sex	Age	Grade Completed	IQ
3	F	7	1	92
*4	M	7	1	108
*5	F	7	1	85
6	M	8	2	124
7	F	8	2	101
8	M	7	2	111
*9	F	8	2	108
10	M	9	2	93
*11	F	8	2	99
12	M	8	3	93
*13	F	8	2	86
*14	M	8	3	117
15	F	9	3	71
*16	M	9	3	105
*17	F	9	2	91
*18	M	9	4	103
19	F	10	4	98
20	M	10	4	109
21	F	10	5	115
22	M	10	4	70
*23	F	11	6	111
24	M	11	5	83
*25	F	11	5	96
26	M	12	6	68
27	F	12	7	111
28	M	12	7	137
29	F	12	7	114
30	M	12	7	98
1 (Shelter Nurse)	F	29	13	99
*2 (Shelter Manager)	M	33	16+	128
32 (Alternate SM)	M	35	16+	116

*Early Exit

physician. On the day of entry consulting physicians examined each subject for current infections. Blood and urine analyses were included as part of the final medical check. No subject was disqualified by this examination. The 28 children and two adults who did enter the shelter were in sound health and free of communicable diseases.

2. Physical Fitness and Psychomotor Testing

Weight, grip strength, leg lift strength, and a measure of endurance (a modification of the Harvard Step Test) comprised the physical fitness battery.

Four tests were employed to measure psychomotor skills: (1) Pursuit Rotor, (2) Mirror Tracing, (3) Stasiometer, (4) Beam Balance. The Pursuit Rotor and the Stasiometer tests were described in previous reports (see Quarterly Report, April - June, 1963).

The Mirror Tracing test requires the subject to trace the outline of a six pointed star while viewing the image in a mirror. A printed star is placed on a table before an upright mirror. A shield is positioned above the star in such a manner that when the subject faces the mirror he cannot see the star directly, but only in the mirror. The subject then attempts to trace the outline of the star by directing his pencil movements from the mirror image of star, hand, and pencil.

The beam-balance test requires the subject to walk a wooden, U-shaped rail in stocking feet. The rail is 1 3/4" wide by 3 3/4" high, and 18' long. Each subject's score is determined by the time required to complete the course without error.

3. Psychological Testing

Psychological evaluation for Experimental Study IV included measures of intellectual ability and of personality. The California Short-Form Test of Mental Maturity was used for appraising mental capacity. The Adjustment Inventory and the California Test of Personality were utilized for personality evaluation.

4. Pre-Shelter Questionnaire

The Shelter Entrance Questionnaire was similar to that used in previous occupancy studies and was for the purpose of gaining information on reasons for participating, expectancies, and family preparedness. It was adapted to the age level of the group.

D. Behavioral and Environmental Measures

1. Observers and Observation Procedure

Two-man observer teams stood three-hour watches around the clock. One observer monitored instrumentation, while the other kept a continuous log of shelter events. Observer forms may be found in the Quarterly Report, June - July, 1963.

2. Environmental Measures

Photographs and instrumentation details of the simulated shelter have been presented in previous quarterly reports. Environmental measures included temperature, humidity, general activity, noise and lighting variation.

Selected shelter events were filmed (16 mm black and white) to be incorporated in a documentary of this series of occupancy studies.

E. In-Shelter Program

1. Shelter Manager Training

Two men were chosen from a group of ten volunteers who had been nominated by the recruitment team as possible manager candidates; both were elementary school principals with several children of their own. Selection of the SM and alternate was based upon a staff ranking of the candidates' applications and test performances (see Quarterly Report, July - Sept., 1963).

The Training sessions were four in number, totaling nine hours. They commenced approximately three weeks prior to shelter entry with one session during each of the first two weeks and two sessions during the last week.

During the first training session, both men were given an overview of their training, observed the shelter environs, were familiarized with pre- and post-shelter schedules, and were given basic CD literature and former research reports. The second meeting was devoted primarily to description, explanation, and familiarization of shelter equipment and supplies. Activities and schedules were also discussed with emphasis upon the problems pertinent to the anticipated situation. A suggested daily program was outlined, and the candidates were stimulated to think of variations or improvements and to incorporate these in their planning. The third meeting was devoted to procedures for handling records, th quota system, the duties of the shelter nurse, and to specific exercise and games that were found to be of interest and value in previous shelter occupancies. Both men were requested to supplement recreational, educational, and physical fitness activities for their use in the shelter. The fourth meeting was a repetition and emphasis upon details of previous meetings. In addition, the SM candidates were given instructions for conducting the psychological and sociometric in-shelter tests. A final review of their training was made and tape-recorded for future reference.

2. Shelter Program

It was stressed during training sessions with the SM and the alternate SM that it would be necessary to have a wide assortment of activities readily available with which to occupy the children. To this end, they were given for study a supply of recreational material in the form of song-books, game-books, and other suggested activity sources. Their instructions were to incorporate their selections with the suggested activities.

The SM and alternate were given appropriate textbooks dealing with radiation and atomic energy on the children's level. A list of lecture and discussion topics were also provided upon which they were to base training efforts. It was assumed that they, being professional educators of grade school children, would be able to prepare a training program dealing with the basics of CD and post-attack recovery geared to this age level.

Omission of all books made in-shelter program planning more difficult. Two reams of 8½" x 11" mimeograph paper (1000 sheets) and a supply of pencils were the only recreational supplies stocked. Another difficulty arose with the defection of the SM after three days in the shelter. The alternate admitted being rather unprepared since he had not actually anticipated going into the shelter.

3. In-Shelter Testing

As part of the experimental nature of the study, the shelterees undertook various tasks which also functioned as part of shelter activities for the most part enjoyed and eagerly received by the children. The following were structured tests conducted during confinement:

1. Three times daily the children reported their perceptions of the time of day, as well as time estimates of the duration of visual and auditory stimuli.

2. On alternate days, the children did the House-Tree-Person drawing test and Most-Unpleasant Concept figure drawings.

3. Sociometric questions were answered by the children on days alternate to the figure-drawing test.

4. Structured diarys were completed twice daily by all shelterees, including the shelter manager and nurse.

5. The shelter manager and nurse completed personal and social adjustment ratings each evening for the shelter group, as well as official daily records for food and water consumption and medical complaints and treatment.

III. Results

A. In-Shelter Test Results

1. Supply Consumption and Usage

Table 3 is a comprehensive list of the items available for shelteree use. Daily records were kept by the SM of the amount of food and water consumed by each shelteree (S).

Water consumption over the six full days of the confinement period averaged 1.0 quarts per person per day while food consumption was 848 calories/person/day. Food calories were approximately one-third from the carbohydrate supplement and two-thirds from the Nebraska wheat-corn-flour cracker (Megowen-Educator Food Co.).

A series of commode chemical tests was initiated in Experimental Study III (Quarterly Report, July - Sept., 1963). The final two tests in the series were conducted in the present study. The commode chemicals utilized are presented in Table 4. These two tests were successful, in that commode odor, although complained of, was mild in comparison with that of previous studies.

During the present study detailed observations were made of the particular use and storage of shelter equipment and supplies. From these observations certain points are noteworthy:

(1) The plastic cups withstand use best when they are marked by number and stored in a cardboard or other suitable container. When not stored, younger Ss tend to toy with them and otherwise be careless in their usage.

(2) Personal items (toothbrushes, mouthwash, cosmetics, etc.) should also be kept in a central location since breakage of glass items may present a hazard.

(3) Control and distribution of food supplies should be limited to a small number of Ss (three or four) in order to minimize waste, maintain accurate records, and reduce confusion. Passing out of food items by two or three persons appears preferable to having Ss line up when space is limited.

Table 3

Shelter Provisions Used in Experimental Study IV

Item	Stocked	Used	Not Used
Cardboard sheets	16	16	0
Medical kit:	-	-	-
Aspirin	250	43	207
4 x 4 Gauze pads	100	64	36
Cascara tablets	10	0	10
Safety pins	8	6	2
Razor blades	2	2	0
Petrolatum	1 lb.	0	1 lb.
Isopropyl alcohol	1 pt.	½ pt.	½ pt.
Salt	1 lb.	3 oz.	13 oz.
Sodium bicarbonate	½ lb.	0	½ lb.
Cotton	1/10 lb.	0	1/10 lb.
Bandaids	6	4	2
First aid booklet	1	-	-
Emergency Health Care Booklet	1	-	-
Sanitation kit:	-	-	-
Toilet paper	2½ rolls	1 4 rolls	3/4 roll
Plastic commode seat	1	-	-
Can opener	1	-	-
Sanitary pads - Jr.	½ doz.	1	5
Sanitary pads - Sr.	½ doz.	0	6
Hand cleaner	½ can	1/4 can	1/4 can
Gloves	1 pr.	-	-
Tie wires	12	5	7
Cups and lids	40	37	3
Instructional sheet	1	-	-
Siphon	1	-	-
Plastic bags	10	0	10
Plastic trash can	1	-	-
Cleaning cloths	2	-	-
Crackers	6540	3078	3462
Water	85 gal.	38.08 gal.	46.92 gal
Carbohydrate Supplement	4200	3960	240
Radiology kit	1	-	-
Pencils	50	2	48

(Cont'd)

Table 3
(Cont'd)

Items	Stocked	Used	Not Used
Stencil paper	1000 sheets	734 sheets	266 sheet
Windex cleaner	1 bottle	½	½
Shelter manager folder	-	-	-
Camera 35 mm.	1	-	-
Film 35 mm.	2 rolls	2 rolls	0
Thermometers	2	-	-
Sociometric questionnaires	60	41	19
Time estimation forms	400	316	84
Adjustment rating forms	20	16	4
Diary forms			
morning	250	139	111
night	250	163	87
Medical Complaint Form	14	8	6
Cracker Consumption Form	3	1	2
Water Consumption Form	3	2	1
Carbo. Consumption Form	3	2	1
Daily Summary Form	9	7	2

Table 4

Commode Chemical Tests in Experimental Study IV

Test	Commode Volume	Amount of Water	Commode Chemical
No. 1	0	1 Qt.	2 Oz. Boric Acid; 1.0 Oz. Sod. Perborate; 1.0 Pt. Mineral Oil
	1/2 Full	0	1 Oz. " " 0.5 Oz. " " 0.0 Pt. " "
	3/4 Full	0	1 Oz. " " 0.5 Oz. " " 0.5 Pt. " "
No. 2	0	2 Qts.	1.0 Oz. Cupric Sulphate; 4 Oz. Sod. Perborate; 0.5 Pt. Mineral Oil
	1/2 Full	0	0.5 Oz. " " 3 Oz. " " 0.5 Pt. " "
	3/4 Full	0	0.5 Oz. " " 3 Oz. " " 0.5 Pt. " "

(4) Water distribution was well handled by two persons ; one operating the siphon as the second records the amount received by each S. There appears to be some difficulty in the use of the siphon as a means of dispensing water. The siphon action is difficult to maintain when the water level is reduced to less than half the drum. Shelter managers have in previous studies resorted to filling an empty biscuit tin by siphon and then dipping (by use of a plastic cup) water to fill individual cups. This method could present a health hazard. The SM in the present study used a large paper clip to maintain siphon action.

(5) The cardboard mats were usually used only for sleeping and were stored (stacked in the latrine area) during the waking hours. This action prevented excessive wear and contamination by spilled food and water.

(6) A policy was established concerning the use of the commode. Since the Ss were young, contamination of the toilet seat was avoided by having all children sit when using the commode. Wetting of the toilet seat by younger male Ss had proven to be objectionable in earlier studies. The cover was replaced after each commode use.

(7) Daily policing of the shelter avoided collections of trash and also served to provide another organized activity for the Ss.

2. Defections

A total of twelve defections occurred. Of this total 11 were children and one was the shelter manager. The shelter manager informed observers of his desire to leave and left the shelter after 51 hours in confinement. He was replaced by the alternate manager who remained in the shelter until the scheduled exit. Two children left the shelter approximately three hours after entry. Three left on the day after entry and four left on the following day. Two more left in the afternoon of the third day and the last unscheduled departure was made after 95 hours in the shelter.

Most of the children who left were of the younger age group and the prevalent cause for discomfort was homesickness and inability to adjust to such a relatively strange environment. General reasons for leaving as stated by the shelteree to the interviewer are listed in Table 5.

3. Shelter Events

Each observer of the two-man team continuously recorded independent observations of in-shelter events. These observations were abstracted and one (the #1 observer log) is presented here as a chronological account of shelter events:

Saturday, July 20

The Ss entered the shelter at 1700. Introductory talk by SM, explaining equipment and stressing that all Ss were to obey SM and SN. Outlined general procedures, conservation of supplies, toilet paper--"Don't waste it;" drinking cups--"Don't step on them, drop them, or play with them." Explained food supply and ration. Group generally attentive. Ss removed shoes and stacked them in a corner. 1800--noise level high, much ye'ling--SM tried to stop it--little success. Ss received cracker, carbohydrate, and water ration. All ate and drank. SM explained time estimation procedures. Number 13 crying for some time. SM called, #13 and #4 want to leave, and were removed shortly. Ss completed diary forms and prepared for bed. Cardboard distributed and Ss retired at 2204 hours. Some talking after "lights out."

Sunday, July 21

During the night some sobbing and occasional crying out of some Ss. Generally quiet. 0710, Ss awoke and arose with much talking and noise. Received food and water ration. Cardboard collected. Number 9 and #18 crying and comforted by SN and #27. Much activity during morning. SN was very active in management of group. Number 8 and #20 in fight, stopped by SM. SM ignored much group activity. Ss completed time estimation, diary forms and engaged in ill controlled exercise program. Rest period followed--not accepted by all. SM reprimanded children--appeared short tempered. Number 18 crying again.

Table 5

Defecting Shelterees' Reasons for Leaving
in Order of Exit

Time	Day	Date	Shelteree Number	Sex	Age	Reasons
		July				
2025	Sat.	20	4	M	7	Urinated upon self - embarrassment.
2025	Sat.	20	13	F	8	Wanted to go home.
1200	Sun.	21	9	F	8	Sore throat. Cold, did not like the water.
1200	Sun.	21	18	M	9	Didn't like food. Didn't like the water.
1600	Mon.	22	17	F	9	Sore throat. Crackers hurt teeth. Trouble sleeping.
1600	Mon.	22	23	F	11	Real tired, sore hips, dizzy. Cold, didn't like crackers, just sick all over, noise.
2000	Mon.	22	11	F	8	Homesick. Didn't think crackers were too good.
2000	Mon.	22	5	F	7	Wanted to see her mommy and daddy. Floor was hard.
2000	Mon.	22	2	M	33	No specific reasons. Temporal disorientation.
1320	Tues.	23	14	M	8	"Sick as a dog." Red throat, stomach-ache, headache, vomited.
1320	Tues.	23	16	M	9	Didn't feel so good, wanted real food. Crowded, hot then cold, hated food at first, chemical toilet terrible, hated girls.
1540	Wed.	24	25	F	11	Running fever of 101°. Crowded sleeping, too cool then too warm, didn't like smell of H_2O, mild dislike of chemical toilet.

SM called 1143, to inform that #18 and #9 wished to leave--they were removed. Afternoon filled with singing (hymns), time perception tests, draw picture tests, rest period, and eating. Group generally out of control of SM. Evening diary forms and time estimation forms completed. Cardboard placed and general retirement completed by 1830. Talking and noise after lights out.

Monday, July 22

At 0710 Ss awoke suddenly with much talking. Food and water distributed, #29 and #17 were crying and being comforted by SN. The SN took temperatures. Number 24 then crying. Diary forms and time perception forms completed. "Pin Tail on Donkey" played. Clean-up period followed. At 1120 rest period began. 1233 rest period ended and exercise period began (poorly conducted). Noon meal. During the afternoon, the Ss completed time estimation forms, sentence completion forms, and free discussing. Ss appeared in good condition with singing and random playing. Little interest shown in these activities. SM gave short talk on radiation survey equipment. Little interest or attention. Later gave talk on blast effects with somewhat more attention. At 1510 SM called to say that #17 and #23 wished to leave. He also indicated that he wished to leave also. The younger Ss were removed. The SM was later removed. He conferred with the staff, and returned to the shelter. At 2002 hours, the SM was removed along with two other children, #5 and #11. Group generally excited, calls of "Chicken!" were directed toward SM. The alternate SM was sent in. Better control was gained by new SM with able assistance of SN. Very strong address by new SM with emphasis upon quiet and orderliness. Ss much quieter. Rigorous clean-up conducted, cardboard placed for night and quite orderly retirement. Whispered conversation after lights-out. Quiet night.

Tuesday, July 23

#14 nauseated and vomiting at 0425. SN attends with aid of SM. Other Ss generally quiet. Most were asleep. #14 went back to sleep. Slow waking, gradual increase in conversation and movement to 0917 when lights were turned up. Comparatively calm atmosphere as Ss began morning

meal. #14 appeared O.K. then. The morning diary forms, time estimation forms, and exercise period were completed. More cooperation and order in exercise program. No planned activities were initiated, but Ss talk with SM who appeared to have group under control. 1207 SM called to say #14 and #16 wished to leave. #14 appeared to be somewhat nauseated. Rest period followed. Much talking. A game ("Hot Potato") was then played, with enthusiastic participation. Following the removal of #14 and #16 at 1320, the afternoon was filled with games ("Charades," "Limbo Dancing," "Tic-Tac-Toe") and time perception test. Temperatures were taken and all were normal. The Ss' morale appeared very high. This general atmosphere continued during the evening with the completion of the time perception test, diary forms, and evening meal. Orderly retirement occurred at 2155. Very quiet during night. ET 77°, @450 cfm air flow.

Wednesday, July 24.

Ss arose slowly as the previous day. The morning meal was eaten, cardboard picked up, and a general clean-up by 1045. Morale appeared high. Much talking, but not boisterous. The morning diaries and time estimations were followed by games ("I Spy" and "Hot Potato") until 1325 when food and water were distributed. SM has good control of Ss. Number 25 appeared ill (1400-1450). SM called to say #25 had a sore throat with high temperature. She was removed at 1540. Movable wall adjusted to the disappointment of Ss. Space appeared very small at that time. SM said, disgustedly, "Oh, come on!" Following the S removal, the other Ss completed sociogram forms and began a new game ("Poor Kitty") as suggested and directed by SM. An afternoon exercise period was then conducted successfully by SM. Good participation, lasting eight minutes. The evening meal was completed by 1900 hours. SM remarked that he assumed that they would all be there on Saturday. The girls groomed each other, using SN's lipstick (hair combing, etc.) Whispering game ("Rumor") tried but not accepted very well. Ss performed routine tasks (time estimation, diaries, etc.) and retired late at 0042 hours. ET 77°, @450 cfm air flow.

Thursday, July 25.

Very slow waking by Ss until 1100 hours when food and water were distributed for the morning meal. The previous night had been quiet except for "night noises" (occasional crying out of a child, shuffling about on the cardboard, snoring, coughing, etc.) The girls groomed themselves as other Ss sat about talking. The Ss were given paper and pencil and did some free drawings, after which an exercise period was conducted effectively. From 1310 until 1440 the Ss played several games ("Limbo dance," "Poor Kitty, "Hot Potato," "Cluck-Cluck") with very good participation. About 1440 the SM began an excellent lecture on radiation. Very good attention by group. During the afternoon and evening hours the high morale of the Ss continued with the performance of time estimation tests, drawing tests, and evening diary forms. Between these tasks, the Ss play games (dancing "Limbo," "Twist," and "Bug") with participation by all. The evening time estimates were somewhat later than anticipated, indicating a slow passage of perceived time. The Ss remained awake and active until 0110 when the SM began placing Ss for the night, followed by lights out. ET 77°, @450 cfm air flow.

Friday, July 26.

The Ss arose slowly between 1110 and 1135 hours. Water and food were distributed by 1200 hours. The established routine was followed for time estimations (1324) and an exercise period (1340). Songs ("You Are My Sunshine") and games ("Cluck-Cluck") filled the hours between 1400 and 1515. A general discussion relating the ambitions of the Ss lasted until 1545 when the afternoon meal was eaten. Group morale appeared very high. During the remainder of the day, individuals entertained themselves by drawing and talking, or playing in small groups. At 1805 and 2024 time estimations were made, which indicated a "catching-up" with true time. (The first estimate of the day was some three hours behind true time). The evening meal, diary forms, and incidental drawings were completed by 2300 hours. An orderly retirement was effected by 2330 hours. ET 78°, @450 cfm air flow.

Saturday, July 27.

The night was very quiet and the Ss were still asleep at 0810 when shelter exit was scheduled to occur. The Ss were aroused by the E turning up the shelter lights. All Ss were removed and recordings terminated by 0855 hours. All Ss appeared in good physical and psychological condition.

4. In-Shelter Medical Complaints

A daily medical complaint record was maintained by the shelter nurse. A summary of the primary complaints and their frequencies is presented in Table 6. Number of shelterees making complaints ranged from one to six per day. The most frequent complaints were headaches, homesickness, and stomach-ache. A range of other complaints such as "glass in toe" and "nausea" were of minor dimension and for the most part easily handled by the nurse. One shelteree cut his finger on the jagged edge of a food can while opening it.

5. Shelteree Reactions

a. Pre- and Post-Shelter Questionnaires

A pre-shelter questionnaire, similar to that given to Ss in all previous experimental groups, contributed the following insights concerning Experimental Study IV children:

(1) Reasons the shelterees indicated as influencing their decision to participate in the study, in terms of the mean ratings given by 50% or more of the respondents, were: desire to help their country, desire to learn self protection from fallout danger, desire to help the University of Georgia, curiosity, payment, and as a test of personal endurance.

(2) General preparedness for a nuclear emergency was more evident among the early-exit children than among those who remained in the shelter for the duration of the study. Of both groups of Ss, over 50% reported having received civil defense training at home or in school, knowing the location of a fallout

Table 6

Summary of Primary Items on Medical Complaint Record

Day	Number of Complaints				
	Total[a]	Headache	Homesick	Stomach-ache	Other[b]
July 20	1	0	0	0	1
21	5	2	4	3	4
22	3	1	1	0	1
23	5	3	1	1	4
24	6	3	0	1	2
25	2	0	0	0	2
26	2	1	0	0	1
Totals	24	10	6	5	15

[a] Total number of shelterees making complaints each day

[b] Includes fatigue (2), sore throat (1), nervousness (1), pain in chest (3), nausea (2), toothache (2), glass in toe (1), infection (3)

shelter in event of need, and having heard about what it is like to live in the experimental shelter. Only among the early-exit children did 50% or more answer positively to questions concerning home preparations for emergency by storage of food and water and medical supplies.

(3) The most effective publicity and recruitment effort was the presentation of the project in Ss' schools.

(4) Seventeen (61%) of the twenty-eight children reported knowing another child in the shelter group prior to the day of the group's entrance into the shelter.

(5) One-third of the children gave specific content to comments on their thoughts about shelter life, and these remarks focused on sleeping on the concrete floor, crowded conditions, activities and food.

(6) The only anticipated discomfort factor cited as such by at least one-half the children was "Not enough fresh air." "Bad smells" and "No bathing facilities" received priority discomfort rankings, though less than one-half the group cited them. Early-exit Ss tended to cite more factors as potential discomforts than Ss who completed the study.

Seventeen Ss (ten boys and seven girls) remained in the shelter for the duration of the study and completed the post-shelter questionnaire, similar in form to that given to earlier experimental groups. The following observations are evident from this form:

(1) The boys gave a mean estimate of 5.0 additional days of tolerance for confinement beyond one week, and the girls gave a mean estimate of 1.4 additional days.

(2) All the children said in retrospect that they would have volunteered for the study even if they had known what it would actually be like.

Eighty-eight percent of them said they would volunteer to live in the shelter again, while 59% felt that many of the boys and girls had a hard time living in the shelter. Comments on unnecessary items or additional items for the shelter were minimal.

(3) Aspects of Experimental Study IV which the children mentioned as being most liked were the social interaction with others, activities while in the shelter, and personal and altruistic rewards accrued from the experience.

(4) Aspects of usual, everyday life which at least one-half the children mentioned as being missed, in order of frequency of mention, were customary foods, and family.

(5) At least one-half the Ss reported discomfort incurred from the following conditions (mentioned in order of frequency of mention): food, toilet facilities, sleeping conditions, and lack of time pieces. Eleven Ss cited the food as a major potential reason for defection from the shelter.

(6) Evaluation of specific shelter conditions incurring discomfort primarily emphasized sleep conditions (cardboard pallets not soft enough, no pillow, other people too close); the chemical toilet (bad odor, uncomfortable); unpleasant feelings (homesickness, slow passing of time, hunger, stomach-aches); deprivations (no means of telling time, no radio or television, chewing gum, reading materials, family and friends, playthings); and odors (chemical toilet and water).

Measures of likes and dislikes, desires for additional possessions in the shelter, and sociometric choices, completed by the Ss three times during confinement, revealed the following facts:

(1) Most-liked factors were payment for participation in the study, other shelterees, and the carbohydrate food supplement.

(2) Most-disliked factors were sleep conditions, and food (crackers).

(3) Items which the children mentioned most frequently as wishing they had with them in the shelter were: foods, regular beds, family members, and pillows.

(4) Sociometric choices manifesting a positive orientation fell on the two oldest girl shelterees (#27 and #29); the oldest boy shelteree (#30) was also a "star" in this respect. Ss nominated most often for negative orientation were #6, #20, #22, #28, and #30 among the boys and #3, #5, #11, #15, #21, and #29 among the girls.

b. Shelter Diary Evaluation

With a modified diary form designed to be more useful with grade school age groups, the twice daily writings of each shelteree were examined to determine what factors they considered most bothersome while in the shelter, and what things they felt contributed to confinement endurability. Additionally, frequencies of the "likes" and "dislikes" were tallied for each day to measure predominant trends developing as a function of time in shelter.

As in other group studies, frequences of likes and dislikes were most nearly the same on the initial day, with dislikes markedly increasing on the second day and remaining high through the completion of the study (see Figure 1).

Typically, complaints were higher in the morning, and "likes" higher at night. In this, the children are like previous adult groups. Games and recreation activities were most often mentioned as being liked, followed by food and in-shelter testing. Hardness of floor and other shelter inconveniences received the highest tally under "dislikes," followed by food, water and small space. This seeming contradiction in evaluation of "food" disappears when it is recalled that some children who initially praised the diet later changed their minds and expressed dislike for it.

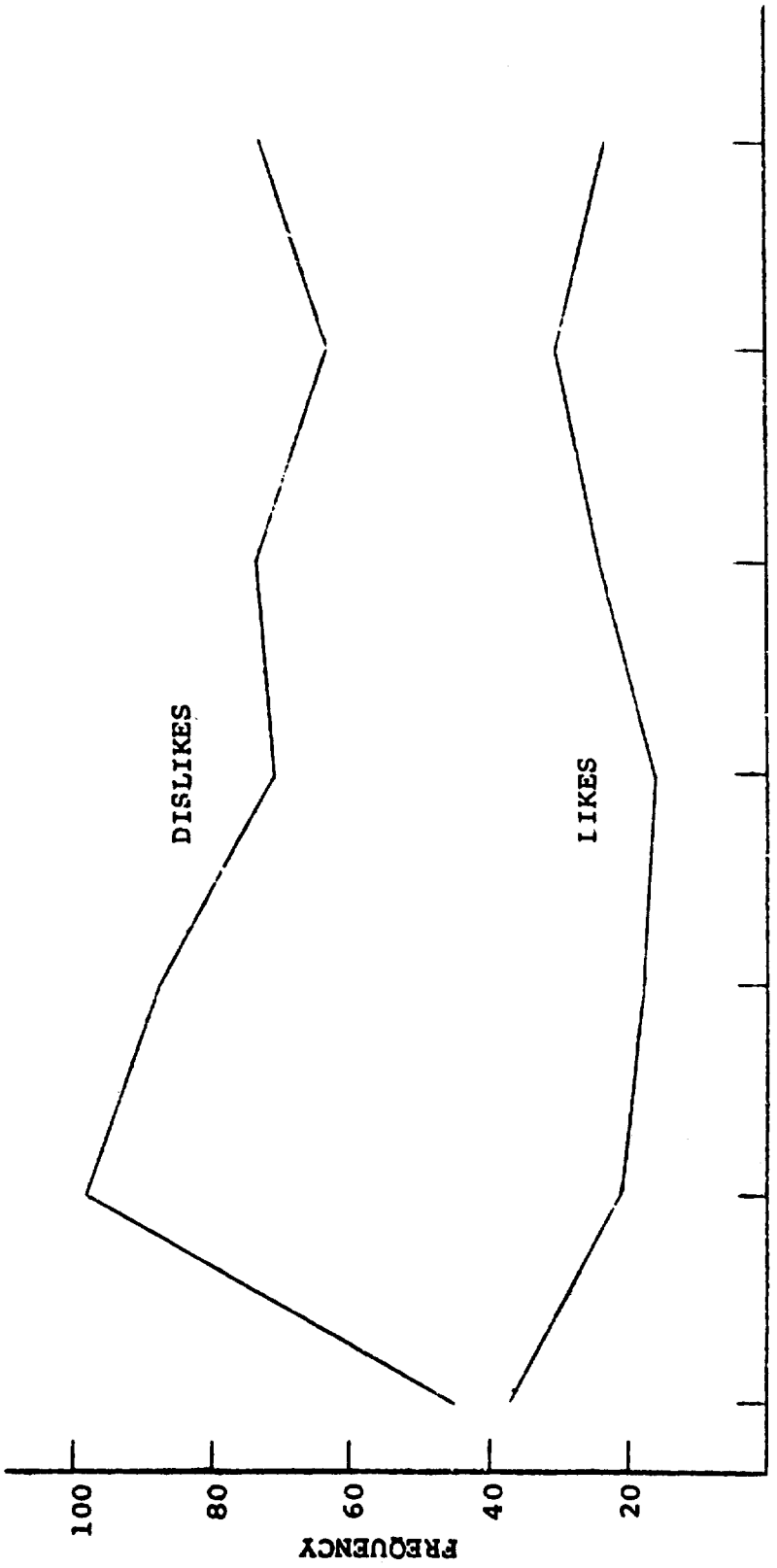

Figure 1. Daily Frequency of "Likes" and "Dislikes" over Confinement (ES IV)

c. Shelter Manager Reports

During the present study two shelter managers were employed. Following their shelter stay, they were asked to submit reports concerning their training, in-shelter experiences, and evaluation of shelter occupancy problems. The original SM who chose to leave the shelter at 2000 hours on the third day was replaced by the alternate SM who remained until termination of the study. The post-shelter reports and personal interviews indicated a lack of sufficient self-confidence combined with reduced motivation which contributed to the defection of the original SM. The alternate SM, while having some misgivings concerning his own abilities, adapted to the shelter environment and gave an adequate performance for the remainder of the study.

6. Observational Data

One observer completed an hourly observation form to measure (1) gross activity of shelterees under ten arbitrary categories, (2) social interaction, (3) training and activity programs, and (4) equipment use.

Frequency counts were made of bodily positions and activities of the group every fifteen minutes. Daily and grand means over each category samples are presented in Table 7. The grand means present the same relative order of position and activity rankings as found in Experimental Studies II and III. Daily patterns of activity will be compared to that of other occupancy groups in the final report.

7. Behavioral and Environmental Data

The effective temperature (ET) was adjusted to the preferences of the Ss and ranged between 69 and 78° at three air flow rates (450, 850, or 1200 cfm). These were control variables and did not constitute a source of stress to the Ss.

Table 7

Daily and Total Mean Frequency Counts of All Behavioral Categories Sampled During Shelter Occupancy

	Position			Activity						
Day	Lying	Sitting	Standing	Sleeping	Exercise	Eating	Recreation	Training	Conversation	Quiet
July										
21	62	23	9	46	1	4	1	1	17	23
22	45	39	14	34	1	6	2	2	22	18
23	48	29	17	37	1	7	9	1	19	23
24	44	41	19	34	2	7	21	4	26	14
25	43	41	15	36	2	5	19	4	20	19
26	52	36	10	38	1	5	7	1	20	27
Total	294	209	84	225	8	34	59	13	124	124
Mean	49	35	14	38	1	6	10	2	21	21

Measures were made of general activity, noise, and lighting levels throughout the study. Extensive comparisons between these measures as well as day to day analyses of each variable revealed no consistent changes as a function of shelter confinement. However, these measures did reflect the day by day activities of the Ss.

8. Time Estimation Data

In an effort to evaluate the effects of confinement upon the ability to estimate the passage of time, the Ss were asked to make judgments as to the hour of the day three times daily. They also judged the duration of light and auditory stimuli as part of the above task. The data analysis is in progress and will be reported in the final report. Figure 2 shows the mean error in estimating the time of day for each day of confinement. The curves represent the comparison of three age groups in relative accuracy in ability to judge the passage of time. Statistical evaluation of the differences between these curves has not been completed; however, the overall trend of the curves is of interest. It is seen that on the first three days of confinement the Ss overestimated the true time of day indicating accelerated passage of perceived time. This may have been the result of the novel experience of shelter living, while later adaptation to this environment accounted for the slow passage time as indicated by the consistent underestimation of true time on the last three days.

B. Pre- and Post-Shelter Test Results

1. Medical Examinations

Post-confinement medical examinations of the seventeen children who completed the study indicate that all subjects emerged in good health. The only significant change for both males and females was a loss of weight. The mean loss for the group was 3.9 pounds (4.4 pounds for males and 3.0 pounds for females). In terms of percentage of original body weight, the loss ranged from 0-8 percent for males, 1-6 percent for females (see Table 8).

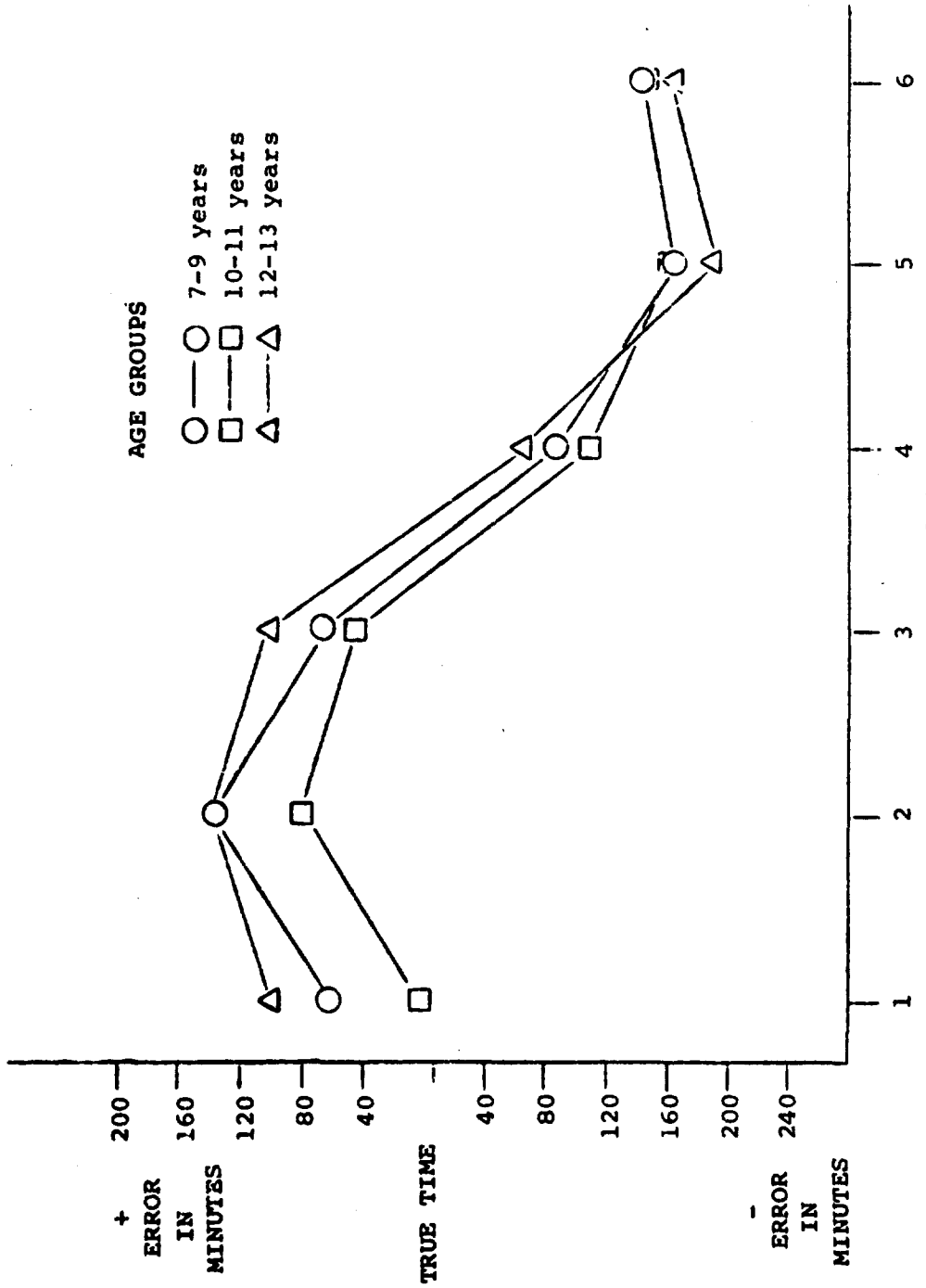

Figure 2. Mean Daily Estimations of Time of Day for Three Age Groups (ES IV)

Table 8

Pre- and Post-Confinement Test Results for Physical Fitness, Psychomotor, and Psychological Test Batteries

Test	Boys (N=10) Pre	Boys (N=10) Post	Girls (N=7) Pre	Girls (N=7) Post
Physical Fitness				
Weight (lbs.)	77.0	72.6	70.6	67.6
Grip Strength (lbs.)	92.2	99.4	61.7	69.1
Leg Strength (lbs.)	195.0	135.0	130.0	120.0
Step (minutes)	3.7	3.6	3.6	3.6
Psychomotor				
Pursuit Rotor (minutes)	.010	.022	.002	.006
Mirror Tracing (score)	23.7	12.2	39.0	17.4
Stasiometer (score)	124.6	107.8	100.7	127.9
Beam Balance (seconds)	33.3	14.4	17.7	14.1
Psychological				
California S-F Test of Mental Maturity (I.Q.)				
Language	102.4	102.9	104.4	115.4
Non-Language	94.1	102.1	95.9	115.3
Total	98.6	102.8	100.3	115.6
Bell Adjustment Inventory (Raw Scores)				
Home	8.0	3.9	9.4	6.0
Health	7.8	5.7	9.4	10.3
Social	13.0	10.6	13.1	11.1
Emotional	6.2	3.7	14.4	11.9
Total	35.0	23.4	46.4	39.3
California Test of Personality (Standard Scores)				
Personal	49.0	56.7	51.9	56.4
Social	43.8	49.1	53.3	52.1
Total	46.8	52.4	52.0	54.7

2. Physical Fitness and Psychomotor Testing

On the physical fitness battery there were no significant losses from pre- to post-confinement for either grip strength or endurance. However, a significant loss in leg lift strength was recorded. As can be seen in Table 1 this decrement was greater for the boys (60 lbs.) than for the girls (10 lbs.). No significant losses were observed for the group on any of the psychomotor tests.

3. Psychological Testing

The ability level of the 26 children who participated in ES IV was representative of the general population. Total I.Q.s on the California Short-Form Test of Mental Maturity ranged from 68 to 137, with a median of 100 (see Table 8). Changes from pre- to post-testing on the Mental Maturity Test were not statistically significant.

The student form of the Bell Adjustment Inventory and the California Test of Personality were administered both before and after shelter confinement. Analysis of the two personality scales indicates no adverse effect on the personal and social adjustment of the shelterees (see Table 8).

Overall, the children who emerged from the shelter after one week appeared to be in good health and physical condition. No measurable depreciation of intellectual functioning, nor changes in emotional stability were observed.

IV. Conclusions

The following conclusions are apparent from this one-week occupancy study:

(1) The greatest problem resulting in the relatively large number of early departures was that of homesickness and difficulty in adjusting to a strange environment.

(2) The shelter managers did not perform as effectively as previous managers because of their difficulty in accepting an intimate role with children with whom they were normally accustomed to working indirectly

as school principals. The SMs' concern with their personal adjustment to the experience also inhibited their leadership efficiency.

(3) Less than one-third of the children who remained in the shelter reported shelter life to be a personal hardship. All children who remained indicated they would have still volunteered had they known what it would be like and nearly all indicated they would volunteer again for future tests.

(4) Four factors that were named a discomfort by at least half of the seventeen children who withstood the entire shelter stay were food, toilet facilities, sleeping arrangements, and absence of means of telling time.

(5) The conditions of this occupancy did not cause major physical fitness or psychomotor loss, although a statistically significant leg lift strength loss was noted. The only medical change noted was a mean weight loss of 3.9 pounds. There were no deficits found in the psychological test measures.

Appendix G

Instrumentation Data

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Environmental and Behavioral Measures
Experimental Study I

I. Introduction

During a four-day period, December 14-18, 1962, the following measures were taken upon the group of 30 persons confined in the simulated fallout shelter:

A. Room Temperature Variations
B. Room Humidity Variations
C. General Activity
D. Noise Level
E. Lighting Variations

II. Specific Variables

A. Temperature and Humidity - The conditions of temperature and humidity were designed so as to remain within a "comfortable" range for the shelterees. Based upon information obtained from prior studies, the initial temperature setting was 83° dry bulb, with a relative humidity greater than 50%. This combination of conditions produced an effective temperature of 76°. However, upon entry and during the subsequent few hours, the temperature was raised in compliance with the wishes of the shelterees. Since the relative humidity was increased by moisture added from the shelterees, the dry bulb temperature was raised to 87° ± 2°, producing an effective temperature of 79° ± 2°. This temperature proved to be acceptable to the shelterees, although for some it was extreme during some phase of activity within the shelter (e.g., too cool for sleeping hours, or hot for waking hours).

When the mean temperature variations of the shelter at all eight recorded points are considered, the variance in mean temperatures is somewhat smaller, and the mean room dry bulb temperature ranges between 79° and 83°.

B. General Activity Level - The levels of general bodily activity for the four-day confinement period are presented in graphic form in Figure 1. The diurnal patterning of activity is clearly seen in this figure. An apparent decrease in activity after the first 24-hour period should be noted, possibly due to the departure of seven of the Ss.

C. Noise Level - Figure 2 presents the mean values of the noise level changes during the confinement period. The data are here presented in terms of millivolts and are intended to show relative changes in noise level, rather than absolute values. When Figures 1 and 2 are compared, it is noted (as would be expected) that when the Ss were most active, they were also noisier. In contract to the indications of Figure 1, Figure 2 indicates that the level of noise remained approximately the same over the four-day period, even though almost one-third, or seven, of the people had departed the shelter at the end of 78 hours. This fact indicates that the remaining Ss became noisier as a function of time in confinement. These measures are supported by direct observation of certain periods of laughter approaching hysteria.

D. Lighting Changes - Figure 3 presents the measured values of illumination. In addition to the variable lighting, there was a constant lighting supplied from a 10-watt bulb in the latrine, and a 7.5-watt bulb used to produce a slight glare on the shelter side of the large observation window, to aid one-way observation. Although these data do not reveal any unexpected significant changes over the study period, they do demonstrate the capacity for detecting pattern changes in future studies of confinement intervals of two weeks' duration.

III. General Discussion

The foregoing data demonstrate the degree of environmental control and accuracy of measurement of variables which may be affected under longer confinement conditions. The comparison of direct observation and automated recording and the resulting high degree of agreement indicate the consistency of the two methods of data collection.

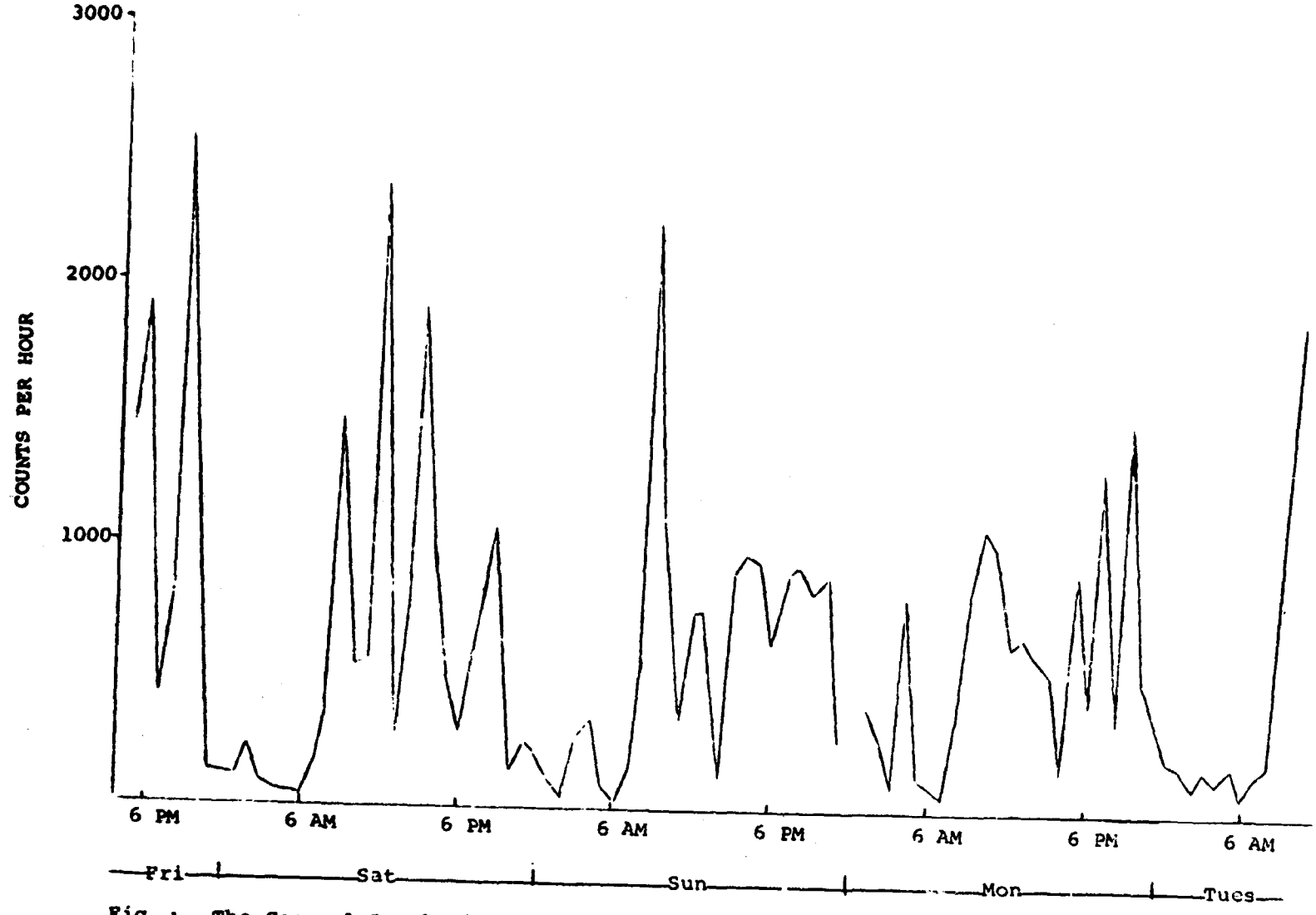

Fig. 1 The General Level of Activity Per Hour (Experimental Study I, four-day confinement)

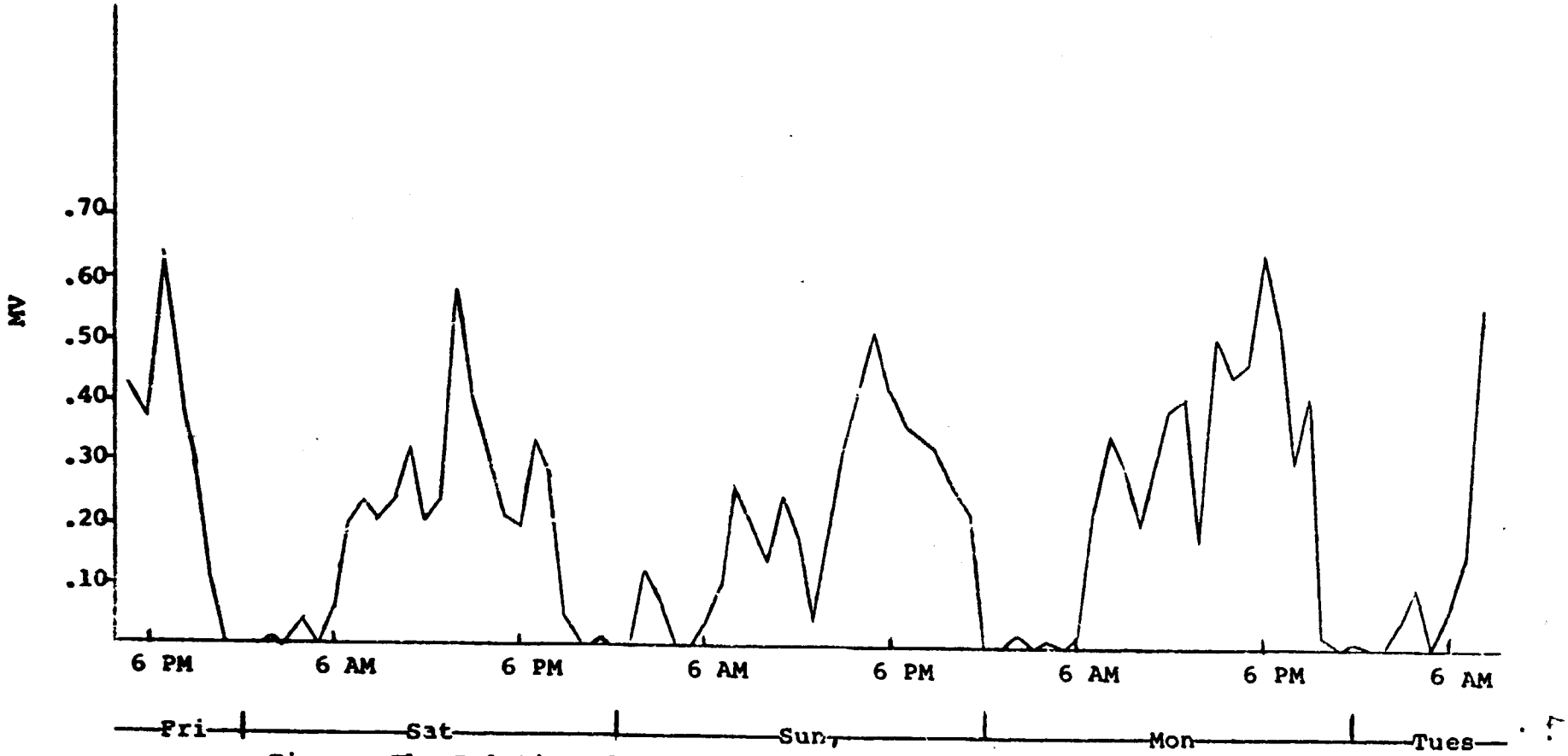

Fig. 2 The Relative Changes in Noise Level Within the Shelter
(Experimental Study I, four-day confinement)

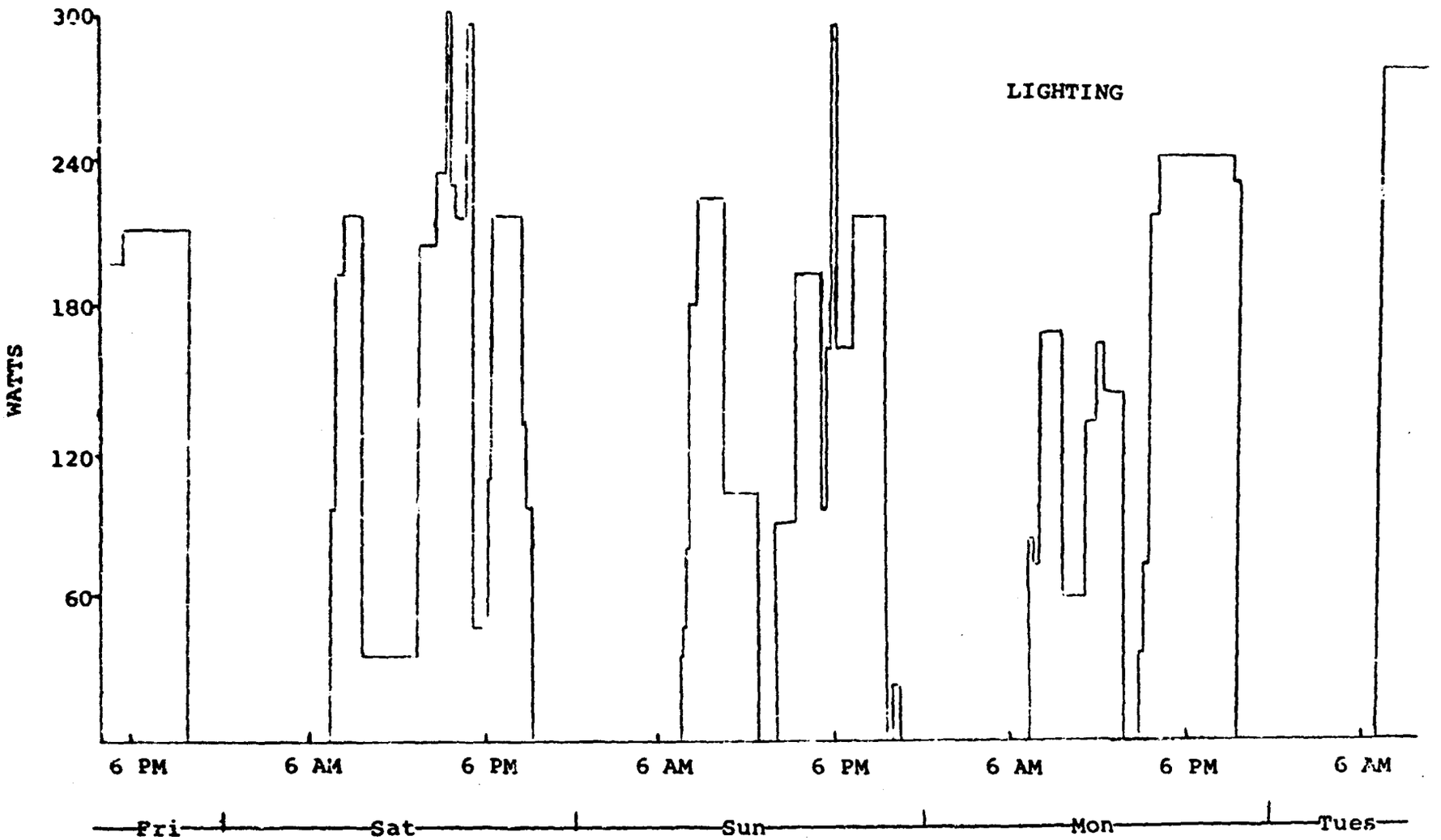

Fig. 3 The Continuous Lighting Recordings (Experimental Study I, four-day confinement)

Environmental and Behavioral Measures
Experimental Study II

A. Temperature and Humidity - The design of this study required that temperature and humidity serve as control variables, therefore being maintained within "comfortable" ranges for the shelterees.

Table 1 presents a summary of the mean effective temperature (ET), mean relative humidity, and ranges of each for the confinement period. These measures were recorded continuously from a wet and dry bulb thermistor pair located 6" from the ceiling on the inside shelter wall. From this table it is seen that the overall ET ranged between 69 and 83° while the relative humidity (RH) ranged between 28 and 69% for the same period. However, it is to be noted that the within-days range for each variable is considerably smaller (0-10° ET) indicating less variability than inferred when considering the entire confinement period. Also, the temperature and/or humidity was changed upon request from the shelterees.

In addition to the measures shown in Table 1, dry bulb temperatures were sampled from thermistors at eight different locations in the shelter. The range for the confinement period and over all eight locations was 76 to 86°. These measures revealed a three degree dry bulb differential between locations near the floor and locations near the ceiling, e.g., 79 - 81° floor to ceiling. The mean value of all locations was 81°.

B. Ventilation Rate - An initial ventilation rate of 15 cfm/person refrigerated air was required. Of the above rate, 3 cfm/person was fresh air while the remaining 12 cfm was recirculated air. A previous study had shown this rate of ventilation to be adequate, considering the group size and thermal characteristics of the shelter space.

However, during the hours subsequent to entry it became necessary to increase the ventilation rate in order to contain the effective temperature within acceptable limits. The ventilation was increased to 40 cfm/person during the active hours of the second day. The original fresh air supply rate was adjusted to 8 cfm/person. This high rate of ventilation was required during active hours for the remainder of the

Table 1

The Mean Effective Temperature and Relative Humidity Variations During the 2-Week Confinement Period of Experimental Study II, Feb. 16 - Mar. 1, 1963

Day	Mean Day E.T.°	Day Range E.T.°		Mean Day R.H.%	Day Range R.H.%		Mean Night E.T.°	Night Range E.T.°		Mean Night R.H.%	Night Range R.H.%	
1	81	77	83	53	50	58	81	80	82	51	48	57
2	78	76	82	54	41	67	76	76	76	51	51	51
3	76	71	81	56	53	62	73	73	73	52	50	53
4	75	73	79	61	54	69	78	78	79	67	65	69
5	71	69	72	60	53	63	72	69	73	50	48	52
6	74	73	76	52	48	58	76	76	76	48	48	48
7	75	73	76	46	45	51	76	75	78	36	31	41
8	77	74	77	33	28	40	77	77	77	31	28	32
9	76	74	77	46	36	50	76	76	76	48	48	48
10	76	76	77	49	48	51	78	77	78	46	44	49
11	76	73	78	44	42	50	82	78	83	40	32	47
12	80	79	83	45	40	55	77	77	77	41	40	41
13	79	77	80	53	40	62	--	--	--	--	--	--

study. However, during sleeping (2300-0800 hours) the ventilation was reduced to the original 15 cfm/person and found to be adequate.

The necessity for the high ventilation rate, and reduction of initial temperature, may be explained by the addition, in this study, of corrugated cardboard as a material to be used for bedding. The shelterees selected to cover the entire concrete shelter floor with the cardboard, resulting in the removal of the heat absorbent function of the floor. Since the walls and ceiling of the shelter were filled with a fiberglas insulation material, the only remaining means of caloric exchange was by ventilation and refrigeration.

C. Lighting - Upon entry to the shelter, a level of lighting of 600 watts was available to the shelterees. This level of lighting was supplied from six 100 w. ceiling lights which could be adjusted individually or collectively by powerstats to any configuration of lighting from 0 to 600 watts. A recording ammeter in the power line measured the changes in total watts selected by the shelterees. In addition to the above, a constant light of 17.5 watts was supplied from two sources. A 10 w. lamp illuminated the latrine area while a 7.5 w. lamp was used to produce a slight glare on the inside surface of a large observation window.

After the defection of three of the shelterees, the available maximum lighting was reduced from 600 to 400 w. on the third day. This maximum of 400 w. was available to the shelterees for the duration of the study. The reduction was a result of the adjustment of a movable wall used to maintain a constant 8 sq. ft. floor space per shelteree; thereby eliminating two of the lighting fixtures from the shelter area.

Although there was available to the shelterees a flexible means of adjusting lighting levels (powerstats), no sophisticated pattern of control was observed or measured. The Ss generally increased the lighting level by short steps upon waking in the morning (0700-0830), reaching a maximum of near 400 w. and remaining there until approximately 2300 hours, the average retirement time. During the two-week period there were occasional changes in lighting during the day but these were of a total reduction nature, i.e., master control reduction of all lights. It was observed on several occasions that when some Ss slept during day hours they shielded their

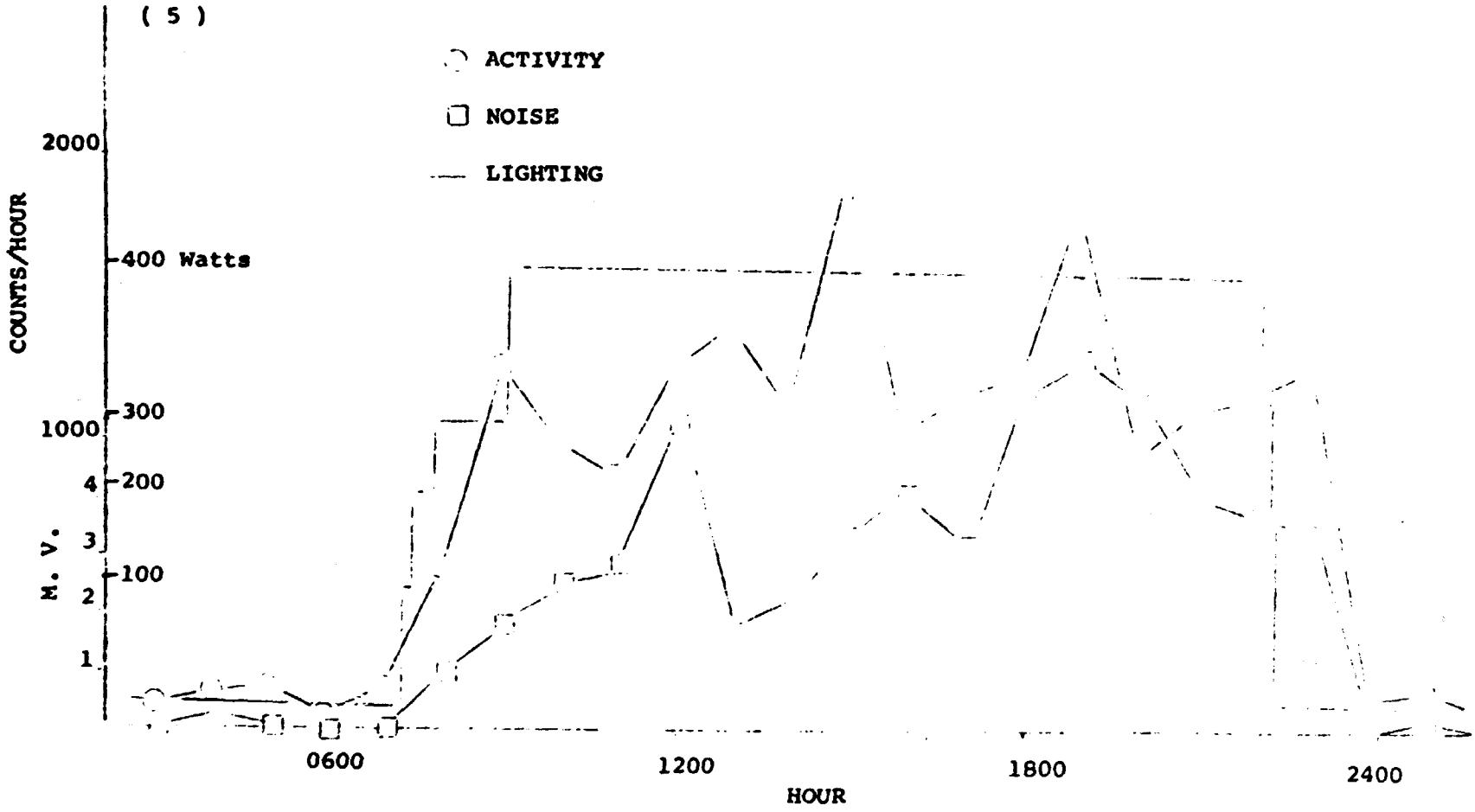

Figure 1 The relationship between lighting, noise, and activity variations. (Experimental Study II)

eyes from the bright lights, rather than reducing the lighting level in their particular shelter area.

Figure 1 shows a typical 24-hour lighting pattern (Day 5_ and how lighting changes were related to activity and noise variations. It is seen here that the increase in lighting from 25 w. at night to a maximum of 400 w. occurs in steps between 0700-0830 hours. A similar step reduction is seen to occur between 2230-2300 hours.

D. Relative Noise Variations - During the confinement period the relative changes in overall shelter noise levels were recorded as described in an earlier report (Quarterly Report, Sept. - Dec., 1962). The recordings were analysed in terms mean noise values over each 15-minute interval during the confinement period. These values were summed for each hour and plotted as a graph for each day.

When consideration is given the total amount of noise for each day of the 12 full days of confinement, there appears to be a slight change as a function of the number of days in the shelter. Figure 2 shows the total noise measured each day for 12 days as related to comparable changes in general activity. There appears to be a general increase in noise level from the first to the third day followed by an apparent decline to the end of the study. The initial increase may have resulted from adaptation of the individuals to the strangeness of the group and the situation, resulting in more conversation, while the decline in noise could be associated with fatique and boredom from the lack of new things to talk about.

Averaging the hourly noise level recordings over the complete 12-day period gave an average 24-hour record. This average or composite graph is shown as Figure 3, along with a similar graph of general activity data. As is seen in this figure, there is an increase in noise level between 0800 and 0900 hours, increasing toward the evening hours. Also, the changes in noise level appear to lag behind changes in activity, i. e., the shelterees move about quietly upon arising and continue to talk after lying down at night.

E. General Bodily or Motor Activity - By the method previously described (Quarterly Report, Sept. - Dec., 1962) a record was made of the amount of movement inside the shelter. These recordings were taken continuously and tabulated every hour. The hourly activity counts were graphed for each day in order

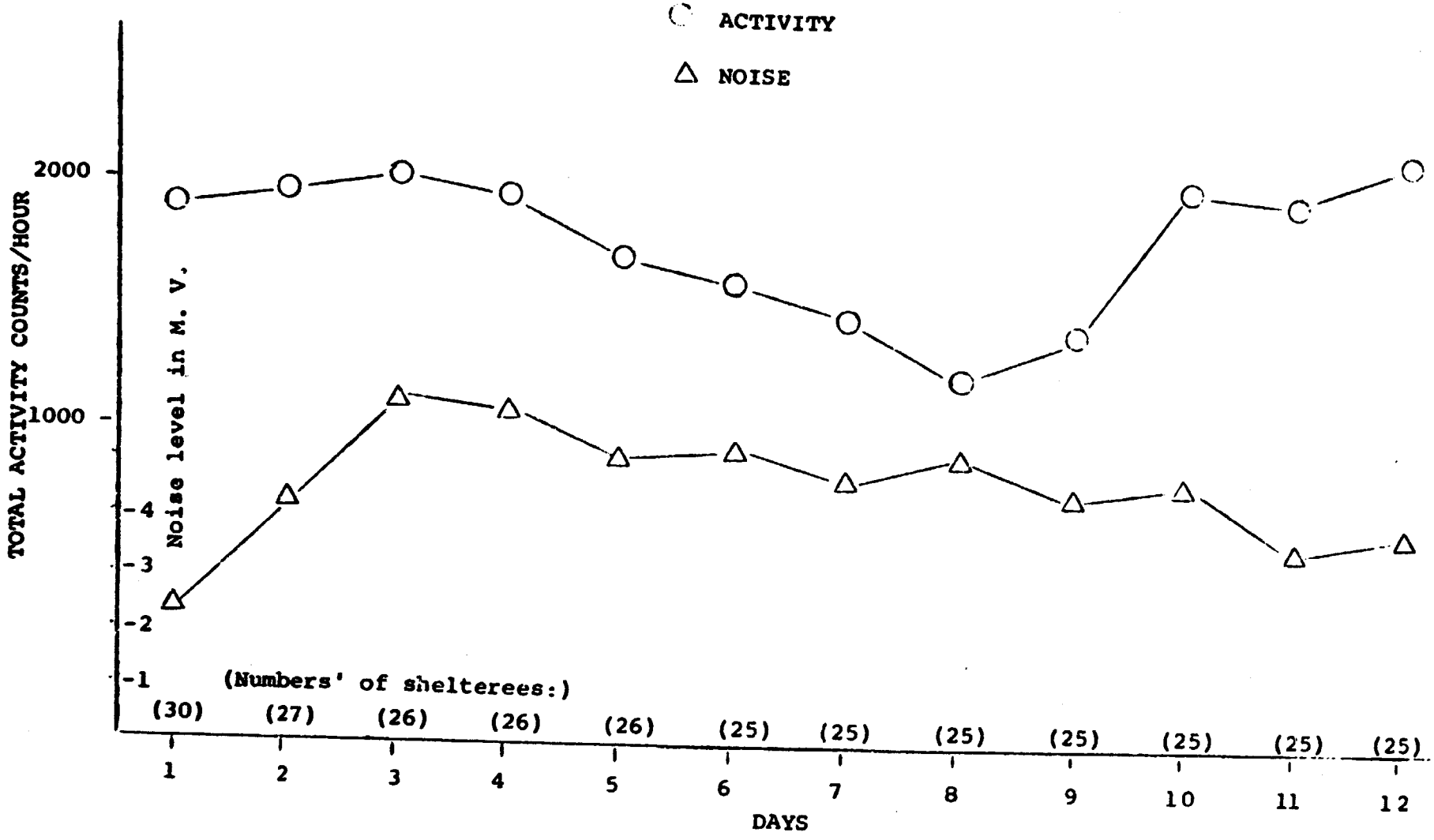

Figure 2 Total daily activity and noise levels
(Experimental Study II)

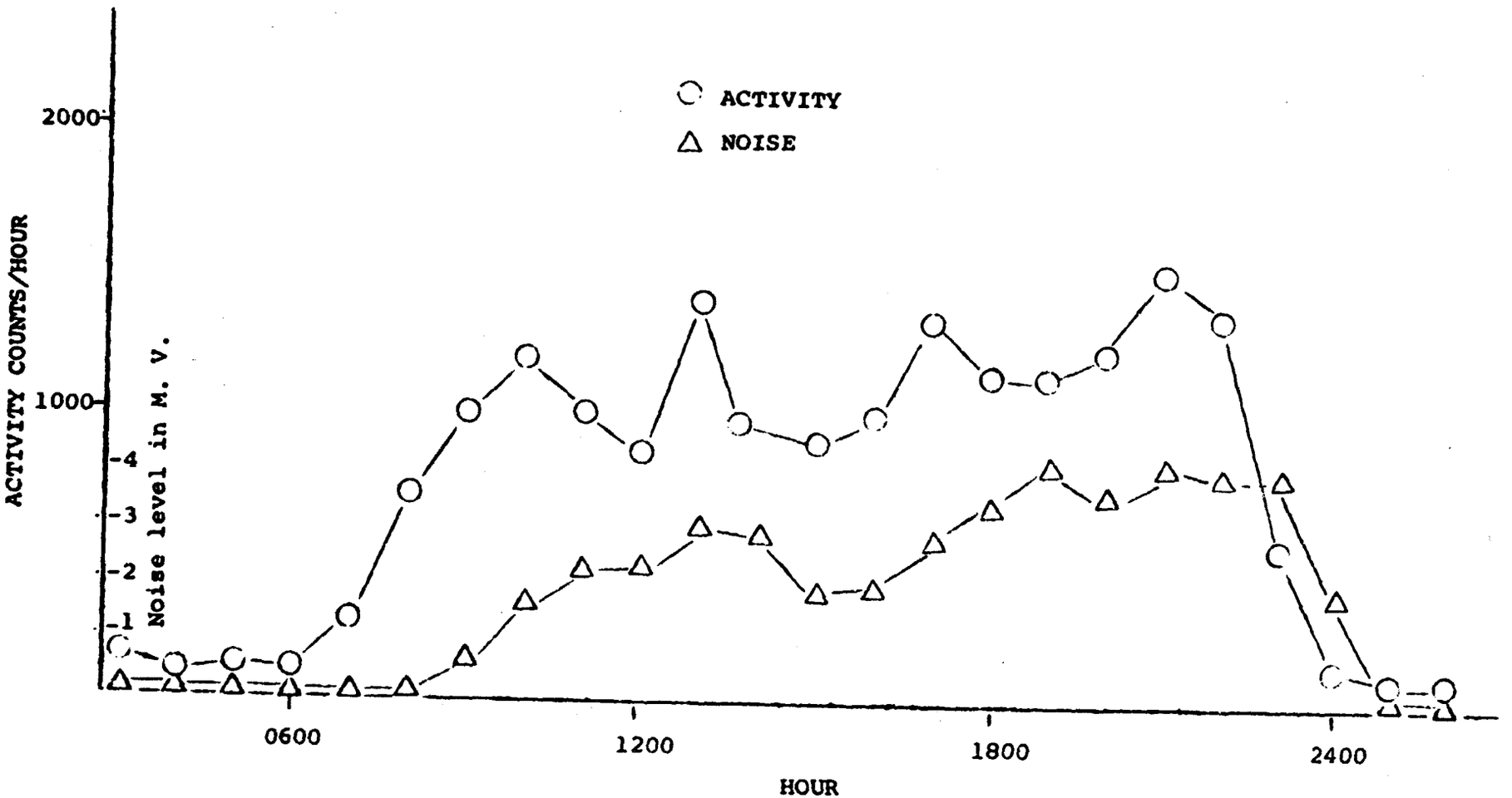

Figure 3 Hourly activity and noise levels averaged over total confinement (Experimental Study II)

to detect possible pattern changes as a function of length of confinement. The data were also summed and graphed for each day in anticipation of day-to-day changes in total amounts of activity.

An example of the relative changes occurring within days is given in Figure 1, depicting five major times of the day where activity is highest. These points correspond to the times of day when food and water were dispensed. The shelterees generally ate four times each day; 0900-1000, 1200-1300, 1600-1800, and 1900-2000. The fifth peak in activity is associated with a cleaning and straightening-up period which preceded retirement after 2200 hours.

The total amount of activity per day for the 12 complete-day duration is shown in Figure 2 along with comparable data on noise level variations. The ordinate scale is expressed in thousands of counts recorded for each day. This figure presents the total amount of activity, ignoring the number of persons in the shelter, since there is no reason to assume all people to be equally active and noisy. The number of shelterees in the shelter on any day is indicated above the figure baseline. As indicated in this figure, there is a slight increase in activity over the first three days which parallels changes in noise level and followed by a general activity decline. Also to be noted is the high increase in activity on the last three days of confinement. As in the case of the changes in noise variations, the activity level may have been affected by the initiation of and adaptation to, a shelter schedule within the first few days while anticipation of release produced the elevated activity near the end.

Comparisons of individual days for systematic changes over the confinement period failed to show pattern shifts in activity or noise. There were, of course, irregular changes between days that did not follow a particular pattern. By averaging the activity measures for each hour over the total confinement period, an average or composite-days' activity was obtained. This composite graph of activity is shown in Figure 3, relative to comparable noise level data. It is to be noted that the typical activity pattern over a 24-hour day shows four major peaks separated by three general times of activity depression. The peaks in activity may be related, as is noise level, to periods when water and food were dispensed - a procedure which necessitated the movement of most shelterees to the water drum.

Periods of relatively low activity are associated with lecture and discussion periods (1000-1200), study and rest periods (1400-1600), and an entertainment period (1800-2000). These periods were loosley organized and did not occur every day.

F. Summary of Noise and Activity Measures - When all measurements of noise and activity are considered, the following general conclusions may be reached:

(1) Activity and noise levels increase over the first four days and may be attributed to adaptation of the individuals to the group, and to shelter life in general.

(2) Following the fourth day of confinement is a period of increasing depression in activity and noise levels that may be associated with resignation to the shelter regimen, fatigue as affected by diet adjustment and sleeping conditions, and boredom from lack of new things to do.

(3) Though noise levels show a slight decline throughout the remainder of the confinement period, activity levels are elevated on the last three days of the study. Since the shelterees were aware of the termination date of the study, the elevation in activity may be related to the anticipation of the exit time.

(4) This study revealed no systematic changes in the basic daily patterns of noise and activity over the confinement.

(5) These measurements are supported by direct observations.

1

Detailed Analysis of Temperature, Activity, Noise, and Lighting Experimental Study III

A. Temperature and Humidity. The present design required that the levels of temperature be selected in accord with the wishes of the Ss.

Wet and dry bulb temperature recordings were taken continuously from a pair of thermistors located inside the air return duct just behind the grille covering. The rate of air flow past this point was measured at 850 fpm during the waking hours, being reduced to 250 fpm during sleeping hours. This change in air flow rate was necessitated by higher required thermal exchange through air refrigeration during the active hours of the day. The lower (250 fpm) air flow rate was preferred during the sleeping hours in order to avoid cool drafts which were objectionable to the Ss. The rate of 850 fpm or 40 cfm/person was necessary in order to maintain an acceptable ET during the periods of high S activity.

Table 1 summarizes the mean values and ranges in ET as well as means, standard deviations, and ranges of relative humidity (RH). As noted in this table, the initial ET was 75° at the time of shelter entry by the Ss. However, the Ss requested that the temperature be lowered to 73° on the second day. To illustrate the temperature levels selected, reference is made to Figure 2, showing mean values and ranges for each day of the confinement period. The temperatures for the first and last days of confinement are omitted in this figure since these were incomplete days with less than 24-hour measurements. From this figure there appears to be a more or less stable temperature preference over the first week, while there is an increase in preferred temperature from Day Nine to the end of confinement. This apparent need for higher temperature may have resulted from the rather austere sleeping conditions combined with a limited caloric intake.

Since the experimental design required that the temperature be "comfortable," it was necessary to increase the ET during the sleeping hours. This was accomplished by raising the ET some two or three degrees after the Ss had retired for the night. Since the time of retirement varied from day to day, so did the temperature change. This change was accomplishe

Table 1

The Daily Means, Standard Deviations, and Ranges of Effective Temperature and Relative Humidity Experimental Study III, April 27 - May 10, 1963

Day	Mean ET	Range ET		Mean RH	Range RH		S D RH
1	75	74	75	66	63	69	2.3
2	73	70	74	81	64	90	6.1
3	73	72	75	79	75	84	3.2
4	73	71	75	72	60	77	5.2
5	72	72	73	55	44	64	4.8
6	72	70	74	54	46	60	2.8
7	73	71	76	55	48	75	4.8
8	73	71	75	62	55	68	5.8
9	74	71	76	64	59	75	5.3
10	74	73	75	68	67	77	2.4
11	75	74	78	75	68	82	2.9
12	76	73	79	76	72	83	3.7
13	76	74	79	75	71	79	2.6
14	75	74	78	76	74	80	2.3

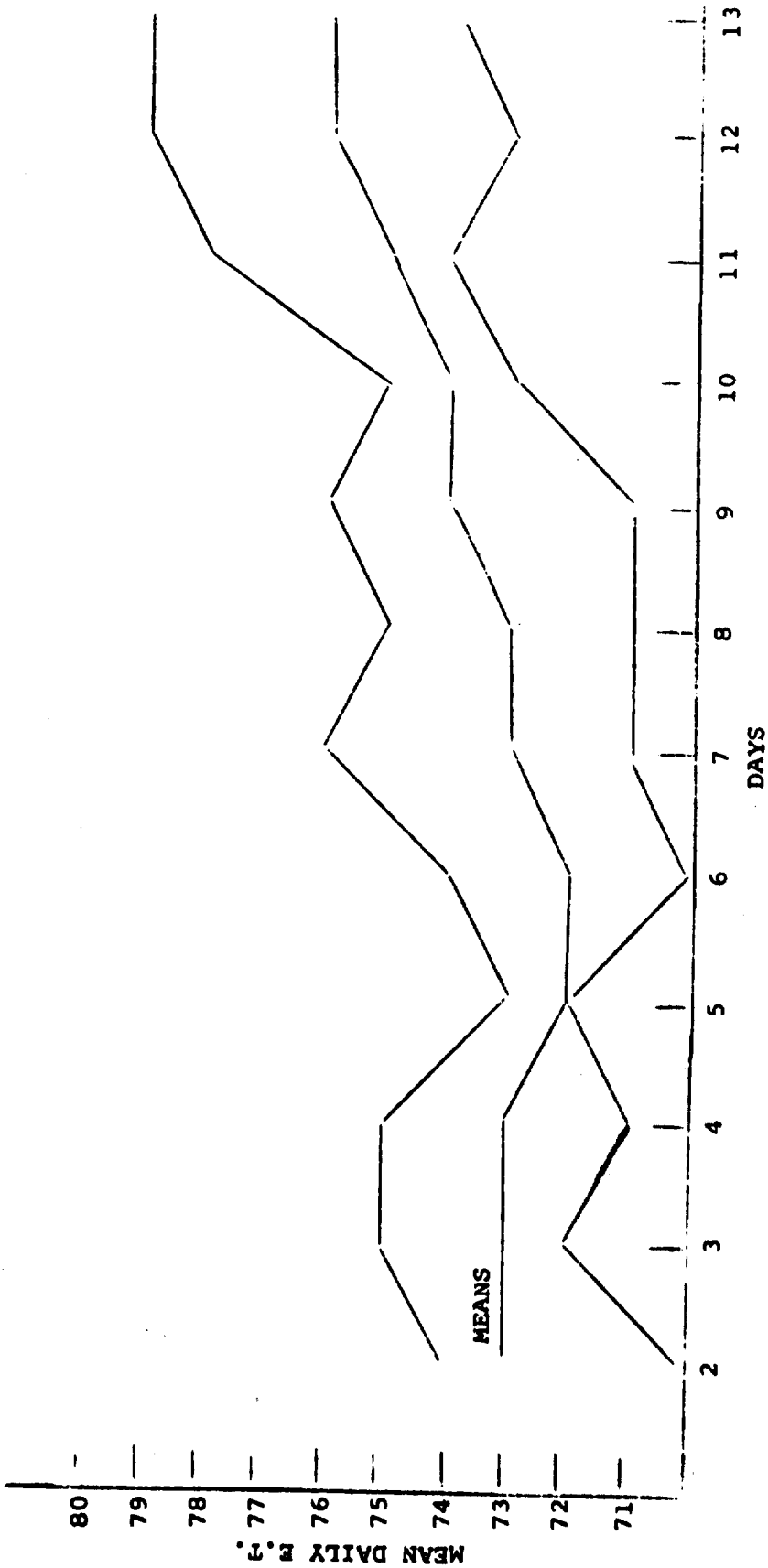

Figure 1--Daily Means and Ranges of Effective Temperature
(Experimental Study III)

by a simultaneous reduction in air flow and increase in air supply temperature. Figure 2 presents the average temperature changes that occurred over a 24-hour day. The points are mean values for each hour over the 14-day period. As is seen in this figure, the temperature was lowered gradually during the hours of increasing morning activity reaching a low point during the mid-day hours, and then raised again at the time of retirement in the evening. Variations in temperature attributable to cooling system instability were less than 1° ET.

The mean variations in RH are found in Table 1 along with the standard deviations for each day. The mean RH for the entire two-week period was 69% with a mean within days variation of 13%. The highest humidity values occurred during the active periods of the day and on days when the local outside humidity was high.

In addition to the above measurements of ET and RH, dry bulb recordings were sampled for 15-minute intervals each hour from eight additional thermistor locations within the shelter. These measurements showed a mean temperature of 78° dry bulb with a range of 73 - 85° over all eight locations for the confinement period. The cement floor temperature ranged between 74 - 80° with a mean value of 77° for the same period. These measurements revealed a 2° differential between floor and ceiling locations.

B. General Bodily or Motor Activity. Utilizing the method described earlier in this appendix, a record of the amount of movement inside the shelter was recorded continuously and tabulated every hour. By graphing the hourly activity measures for each day over the 14-day confinement period, it was possible to inspect these results for any between-day shifts in activity patterns. However, this treatment revealed no systematic changes attributable to confinement per se. There were, of course, random pattern changes between days which reflected temporary variations in shelter routine.

The activity measures were averaged for each day and plotted as a function of confinement. This treatment revealed more interesting results. Figure 3 presents a graph of the mean activity/hour for each day of the shelter stay. Here the first and last days have been omitted since they were partial days and were distorted by activities of shelter entry or exit. This figure also includes comparable measures of noise variations which will be discussed in a later section of this report.

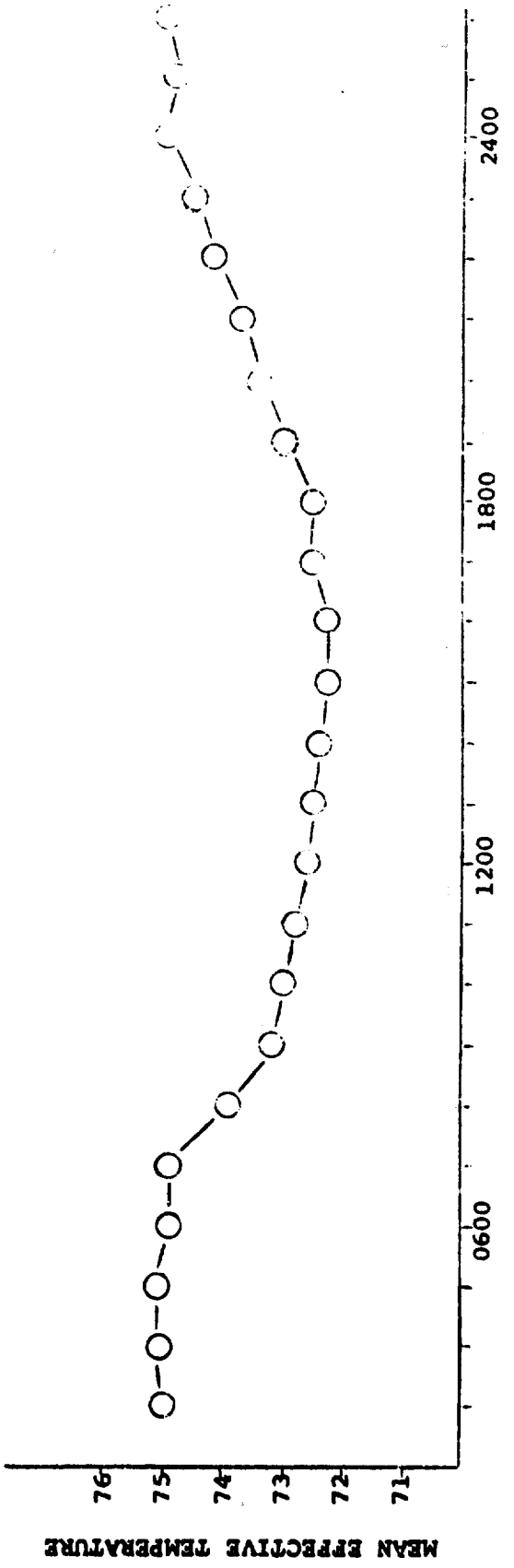

Figure 2 . A composite curve showing an average curve of effective temperature variation over 24-hour period.

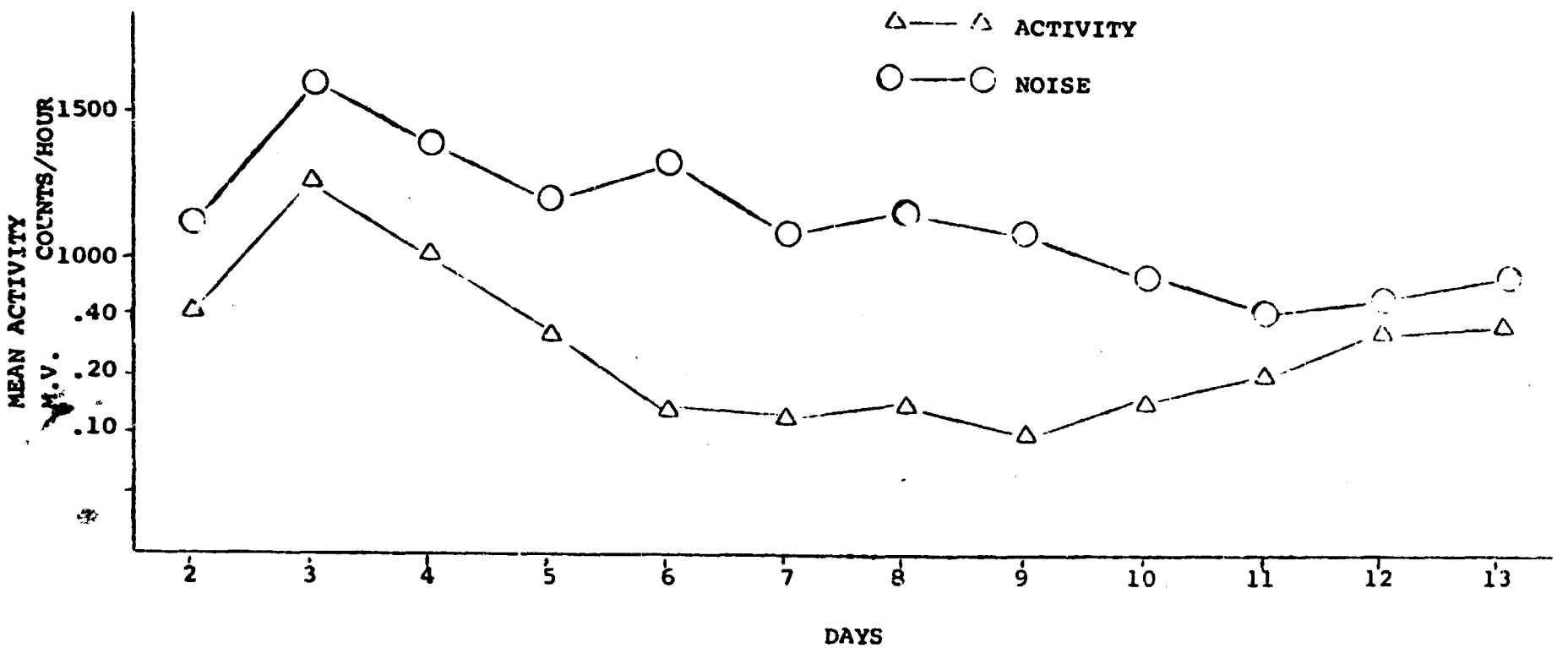

Figure 3 The mean hourly activity and noise levels for each day of confinement. (Experimental Study III, April 27-May 10, 1963)

Indicated in this figure is an increase of in-shelter activity from the time of entry to a high point on Day Three of confinement, followed by a decline to Day Six. A slight elevation in activity is again observed on the last three days of confinement. The initial fluctuations in activity may have been effected by the adjustment of the Ss to the novel shelter environment, while the decline was related to increasing effects of fatigue, boredom, and resignation to the remainder of the shelter stay. Anticipation of completion of the study and release may explain the slightly increased activity near the end of confinement. A prior study of the same duration has revealed a similar activity pattern in Experimental Study II (Quarterly Report, April - June, 1963).

In order to evaluate the pattern of activity for the average day, the hourly activity counts were averaged over the 14-day period to a composite curve of daily activity. This curve is presented in Figure 4 along with comparable measures of noise level variations. As is seen from this curve, the activity began increasing between 0600 and 0700 hours, reaching a high point at 1100 hours. This activity acceleration was associated with the initiation of the daily shelter routine (going to the latrine, getting food and water, storing cardboard used for bedding, and starting of games). The reduction of activity between 1100 and 1300 hours was a result of lecture and discussion periods presented and/or controlled by the shelter manager. The mid-afternoon periods of stable activity resulted from various periods of rest where the lighting was reduced and the Ss lay or sat about having general conversations between small groups. Following the afternoon "plateau," activity is seen to have again increased during the evening hours (1700 - 2000). These hours were occupied by game playing, exercises, and other special events. Retirement for the day came between 2000 and 2300 hours, producing the final activity reduction. Since the Ss had no reference to time, the periods of activity occurring each day, though essentially the same in duration, varied as to the time of initiation from day to day.

C. Noise Level Variations. During this study, continuous recordings of relative noise level variations were taken. These data were averaged and graphed for each hour and each day in the same manner as the activity data. The mean noise levels (expressed in MV units) for each day of the shelter stay are plotted as part of Figure 3 The high degree of similarity between noise levels and activity are readily apparent for the

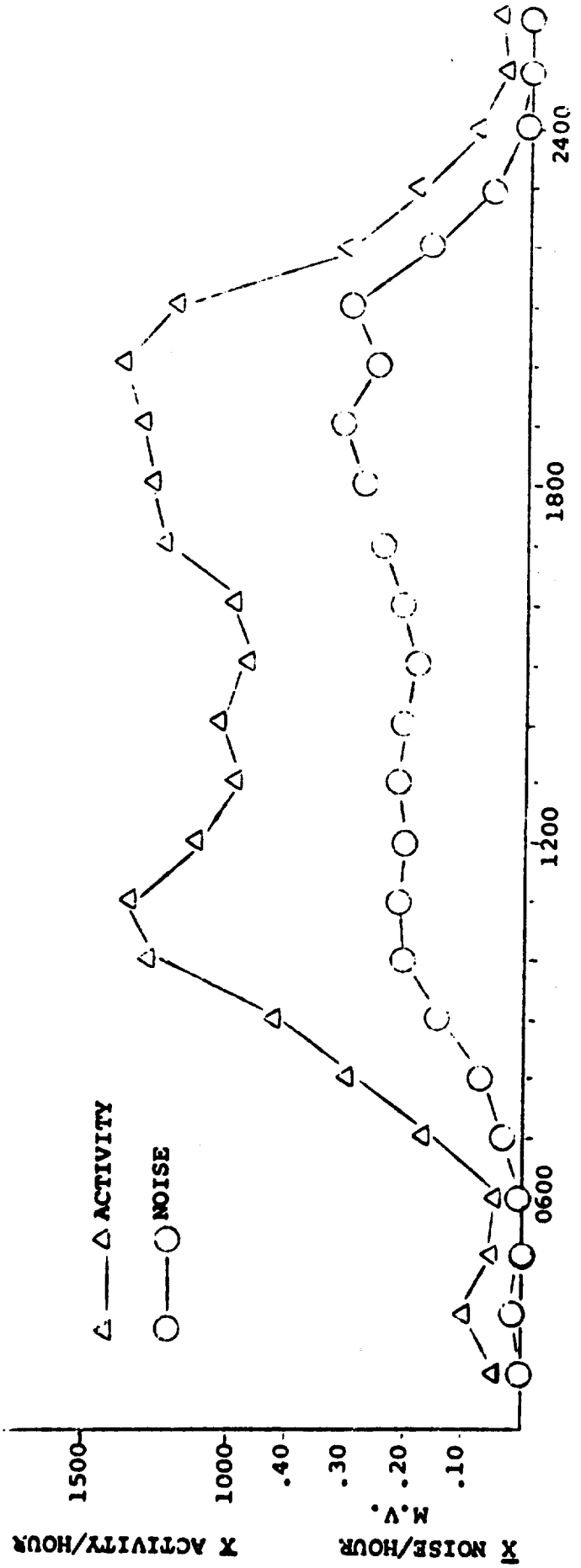

Figure 4 The mean activity and noise level variations for the average day. (Averaged over 14 days.)

first five days of confinement. The general decline in noise levels for the remainder of the study was verified by direct observations of the Ss who spend increasingly more time lying or sitting quietly. Factors of adaptation and fatigue probably explain this curve trend.

Figure 4 graphically presents the mean hourly noise level values for the 14-day period. Shown here is an increase in noise levels beginning between 0600 and 0700, reaching a morning high at 1000 hours, and remaining relatively constant until mid-afternoon. The evening hours are seen to contain the most noisy hours of the day, again associated with periods of vigorous game-playing, conversation and singing.

D. Relationships between Activity and Noise Levels. Visual inspection of the mean hourly activity and noise level data shown in Figure 4 suggests a high degree of correlation. Therefore, to present a numerical expression of this relationship for this study as well as for comparison with Experimental Study II, Pearson product-moment correlations were performed separately between the data curves shown in Figure 5. Again, a high degree of agreement is apparent by visual inspection. Correlations greater than .90 were obtained between curves in Figure 3 as follows: Activity, Experimental Study (ES) II - III, .90; Noise Levels, ES II - III, .94; Activity - Noise, ES II, .92; and Activity - Noise, ES III, .97.

These obtained correlations give validity to the methods employed to measure activity and noise level variables, while suggesting that, under similiar conditions of confinement, a stratified random sample of 30 persons exhibit very similiar activity and noise level patterns. This finding is somewhat surprising since the present experimental group had no standard means (clock, watches, etc.) of time reference. Even when the Ss were in great error as to estimated time (see Sec. III, 5. f. on time estimation) they displayed activity and noise patterns comparable to the group having a time reference. Indicated here is the stability and resistance to change of circadian patterns of behavior.

E. Lighting Variations. Variations in lighting levels selected by the Ss were measured during the 14-day confinement period. This was accomplished by a recording ammeter in the electrical power line supplying current to six 100 w. ceiling fixtures which were controlled by a master and individual powerstats.

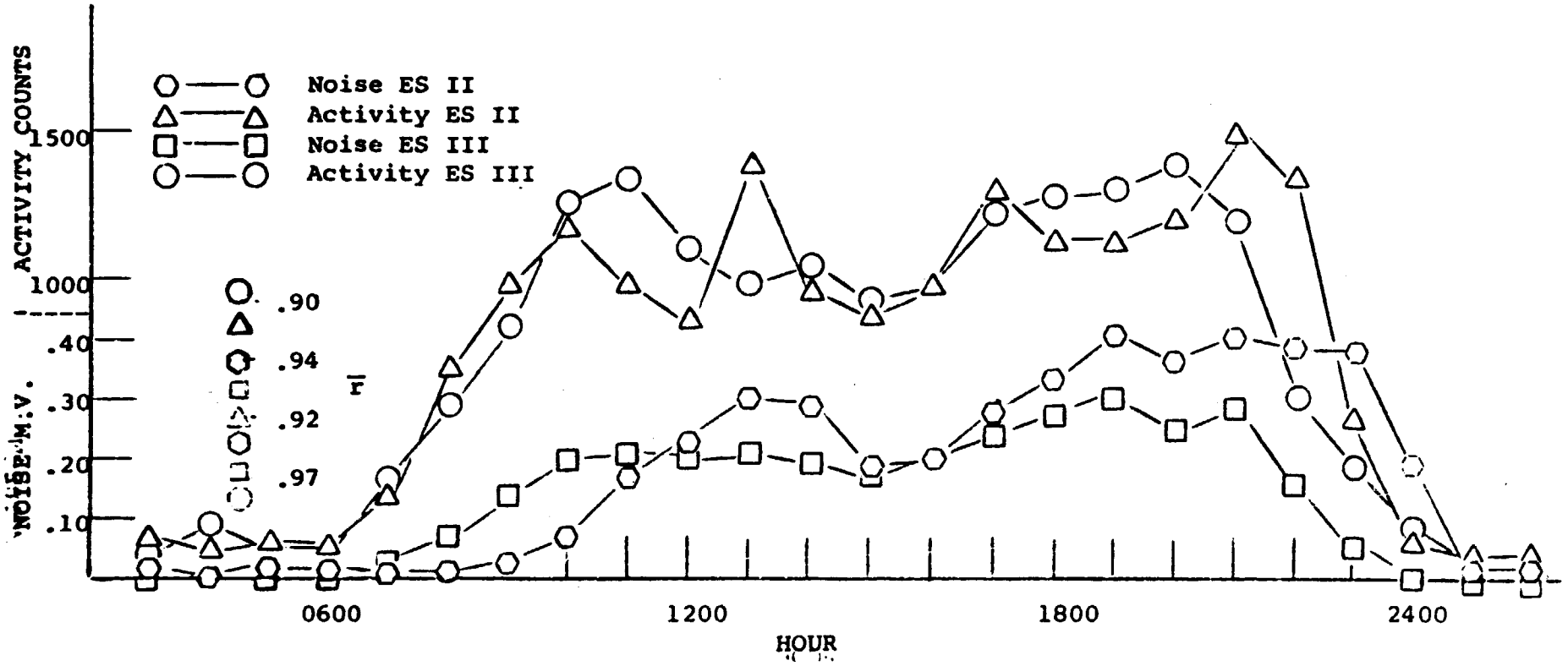

Figure 5--Hourly Activity and Noise Levels Averaged over Total Confinement (Experimental Studies II and III)

Additional fixed lights (a 10 w. lamp in the latrine, and a 7.5 w. lamp used to produce a slight glare on the inside surface of a large observation window) provided shelter illumination. The shelter manager adjusted the lighting level and lighting patterns to the wishes of the other Ss.

The hourly lighting levels for each day were plotted and compared for systematic changes as to intensity, variation, and duration as a function of confinement time. Figure 6 demonstrates the lighting pattern for Day Five, presented here as an example. It is seen that the lighting is raised in steps beginning just before 0800 hours and reaches a maximum (583 w.) at 0900 hours. The reduction of lighting to 133 w. at 1320 hours and lasting two hours was to provide a midday rest period. These reductions occurred on all but three days of confinement (Days Seven, Eight, and Ten). A decrease in lighting by small steps was typical of most days, occurring between 2100 and 2300 hours.

The Ss used most of the available lighting at some period during the day. Also, more efficient use was made of the controls to produce patterns of illumination so as to accommodate both the active and sleeping Ss, than was done in a prior study (ES II).

F. Latrine Usage. The frequency and duration of latrine usage were recorded by means of a microswitch activated by the latrine door. The switch closure was indicated on an event recorder. The frequency and mean duration of the entries were tabulated for each day. However, these measures revealed no systematic changes over the 14-day period. The frequency ranged between 95 and 131 entries with the mean duration ranging between 3.1 minutes and 3.7 minutes for the entire period.

G. Summary and Conclusions. The present study revealed that the mean ET of 74° was acceptable to the majority of Ss during the first-week period. However, somewhat higher temperatures (74 - 76° ET) were preferred throughout the second week. This required higher temperature may have been effected by factors producing fatigue.

Activity, noise levels, and selected lighting levels were highly similar to a prior study, even though the Ss had no standard reference to time, such as a watch. Activity and noise levels were highly correlated in this study (r = .97) as well as with the same measures in Experimental Study II.

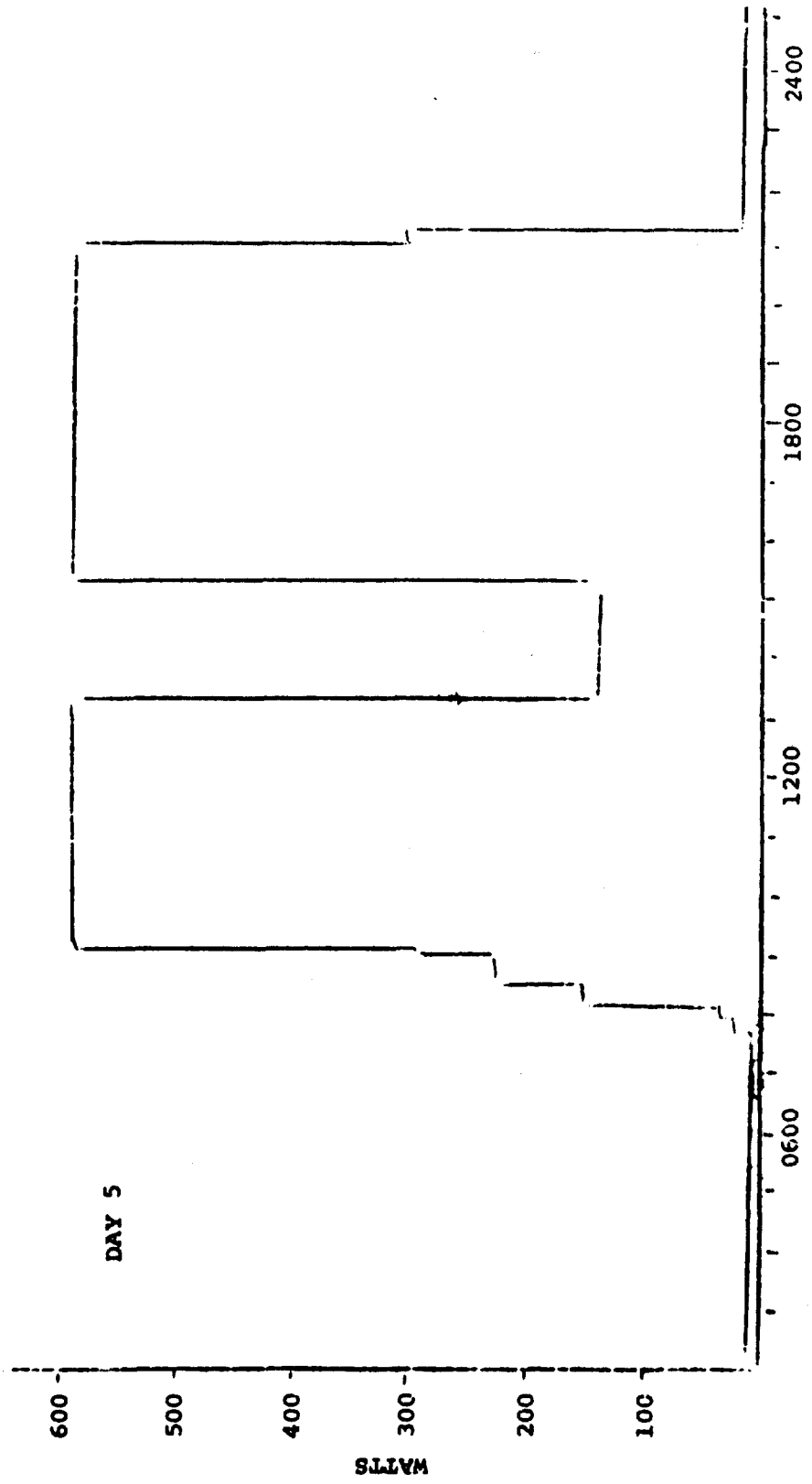

Figure 6. Lighting levels selected by Shelterees on Day 5 of Experimental Study III.

Behavioral and Environmental Data

(ES IV)

A. Temperature and Humidity.--Effective temperature (ET) was controlled by regulation of refrigerated air supply at the request of the Ss. Three rates of air supply were employed, 450, 850, or 1200 cfm. The ratio of fresh to recirculated air was 1:4 for each of these rates. The 450 cfm rate was introduced at night following the retirement of the Ss to avoid objectionable cool drafts, while the 1200 cfm rate was used during active hours. The moderate 850 cfm rate was begun on the fourth day of confinement following the defection of eleven Ss.

Dry and wet bulb temperature recordings were taken continuously from a pair of thermistors located within the air return duct. These measures were compared with readings from a similar pair of thermistors located on the inside shelter wall six inches from the ceiling. ET and relative humidity (RH) determinations were made from the comfort chart of the Heating, Ventilating, Air Conditioning Guide. No correction for air flow rate was applied since the measurements from the above locations were comparable.

Table 1 presents a summary of ET and RH values during the study along with the standard deviations (SD) of these mean values. It is seen that the mean ET values ranged between 73 and 76° over the total confinement period with SD's less than 1.5. Concomitant changes in RH ranged between 81 and 87 per cent with SD's less than 10. Changes in preferred ET by the Ss did not occur in this study as in previous studies (Quarterly Report, April - June, 1963).

Dry bulb temperatures were sampled from eight additional locations within the shelter. Table 2 summarizes the mean values of the recorded measurements from these locations. These measurements are in general agreement with those taken during earlier studies. The mean temperature of the concrete floor was 76° with a range of 75 - 78°: Also, a 2° differential is noted between the 6" positions from the floor and ceiling. This is in agreement with results obtained from the earlier studies (Experimental Studies II and III).

In summary, temperature, as a control variable, was maintained within acceptable limits during the confinement period.

Table 1

The Daily Means, Standard Deviations, and Ranges of Effective Temperature and Relative Humidity (Experimental Study IV, July 20 - 27, 1963)

Day	ET				RH			
	Mean	SD	Range		Mean	SD	Range	
1	74.9	1.2	73	77	84	2.5	71	92
2	76.0	1.0	75	78	83	4.4	75	95
3	74.8	1.3	73	77	81	6.2	49	91
4	72.9	1.6	69	76	83	7.8	65	95
5	73.5	.6	72	75	85	3.4	67	95
6	74.5	1.0	72	76	82	10.4	53	95
7	74.6	.8	73	76	82	3.5	75	90
8	74.5	.5	74	78	87	2.8	82	90

Table 2

Mean Daily Dry Bulb Temperatures Sampled from Eight Locations within the Shelter (Experimental Study IV)

Thermistor	Days 1	2	3	4	5	6	7	8	$\bar{X}$	Location	
1	74.5	77.2	78.0	75.8	75.6	76.6	76.9	77.0	76	1" Within concrete floor	
2	77.1	76.2	79.3	79.7	80.5	80.3	80.1	82.8	79	6" Above floor	
3	77.1	78.7	78.5	77.7	77.3	76.6	77.7	78.0	78	36" " "	
4	80.8	80.0	82.0	80.3	80.8	81.2	81.3	84.1	81	6" From ceiling	
5	73.8	74.7	74.9	75.2	75.2	75.5	76.4	76.7	75	6" Above floor	Behind Movable Wall
6	78.0	76.3	78.2	78.5	79.7	79.7	79.9	83.5	79	36" " "	
7	76.7	78.6	77.7	76.2	76.7	78.2	79.3	79.5	78	6" From ceiling	
8	79.3	77.6	78.8	79.1	80.0	80.4	80.4	83.7	80	6" " "	

B. General Bodily or Locomotor Activity.--Measurements of a general body and locomotor activity were taken in the present study utilizing the Ultrasonic Activity Device (described in Quarterly Report, September - December, 1962). This method permits quantitative evaluation of relative changes in patterns of daily activity as a function of confinement. The measures were cumulated hourly over the period of confinement. Figure 1 3 is included as an example of this activity data treatment. Also included on this figure are comparable curves of noise and lighting variations.

Inspection of the daily activity curves revealed changes compatable with other observations of group behavior. Figure 1 (Day 4) demonstrates the concomitant changes (increases) in activity, noise level, and lighting typical of arousal of the Ss during the morning. Similar changes (decreases) of these variables are noted upon retirement of the Ss at night. Since the Ss had no standard means of time reference (clock, watch, etc.) the time of waking and retirement varied between days as would be expected. However, the ratio of sleeping to waking time remained approximately the same throughout the study.

Owing to the rather large number of defections and subsequent reduction in the size of the shelter by adjustment of the movable wall, reliable measures of the absolute amount of activity each day were not obtainable. The activity device became more sensitive as the wall was moved in, negating any decrease in Ss activity.

In general, activity patterns of the present study agree with previous measures of activity in confined groups (Experimental Studies II and III) and with direct observations.

C. Noise Level Variations.--Continuous recordings of variations in noise level were made during the confinement period. These measures were averaged for each hour. Mean hourly values were graphed for the eight-day study. The daily noise level graphs were inspected for shifts in noise level patterning as a function of confinement. An example of daily noise variations is seen as part of Figure 1. There appears to be a high degree of agreement between noise and activity variations. This high positive correlation is in agreement with the findings on prior studies (Quarterly Report, July - September, 1963). These earlier studies yielded correlations of .92 and .97 between activity and noise level variation on mean values over two weeks confinement. No significant shifts in noise level

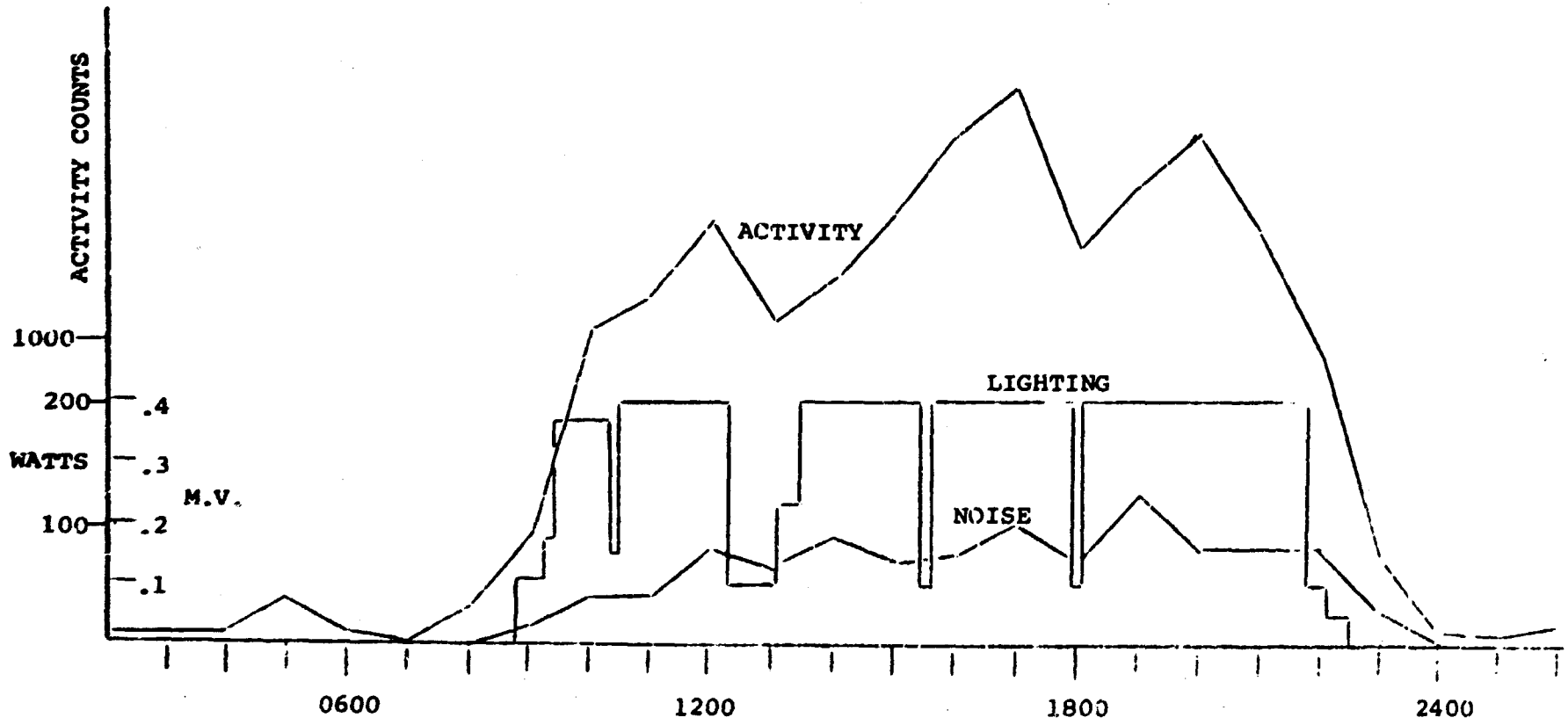

Figure 1 Hourly Activity, Noise, and Illumination on Day 4 of Confinement (ES IV)

patterning were observed.

Movement of the adjustable wall separated the Ss from the microphone supplying the noise level recorder, thereby introducing an unknown attenuation factor. Daily total noise measurements are therefore unreliable.

D. Summary of Activity and Noise Level Data.--When the daily measurements of activity and noise are averaged over the eight day confinement period composite curves are produced as in Figure . This figure included curves of activity and noise level variations over the typical 24-hour day. There is a near parallel increase in noise and activity levels during the morning hours, reaching a maximum level about 1700 hours, and decreasing slowly until time of retirement. A Pearson product-moment correlation yielded a value of .88 between these sets of data points.

During the confinement, there were no significant shifts in patterns of activity and noise levels.

E. Lighting Variations.--Since there was a reduction in floor space from 8 to 6 sq. ft. per person by adjustment of the movable wall, only four 100 w. ceiling lamps were available for shelter illumination. A 10 w. lamp was used to light the latrine, while a 7.5 w. lamp was employed to produce a glare on the inside surface of a large observation window. A recording ammeter in the power lines supplying the four 100 w. lamps provided continuous measurement of changes in lighting selected by the Ss. A Weston 603 light meter indicated floor-level illumination was 4 - 6 foot-candles at the maximum light setting. This measurement was taken in the empty shelter and included reflected light from the walls. The true illumination level (while occupied) was probably somewhat less.

Again, reference is made to Figure as an example of lighting changes selected by the Ss. On the day (Day 4) these measures were taken, only two 100 w. lamps were available owing to prior defections and subsequent adjustments of the movable wall. From this figure it is seen that the Ss selected maximum (200 w.) lighting during the major part of the waking day, being reduced to 50 w. during a rest period, and 50 - 75 w. during brief periods associated with time estimation (estimations of the duration of light signals from a red 7.5 w. lamp mounted near the ceiling). During the night, the Ss

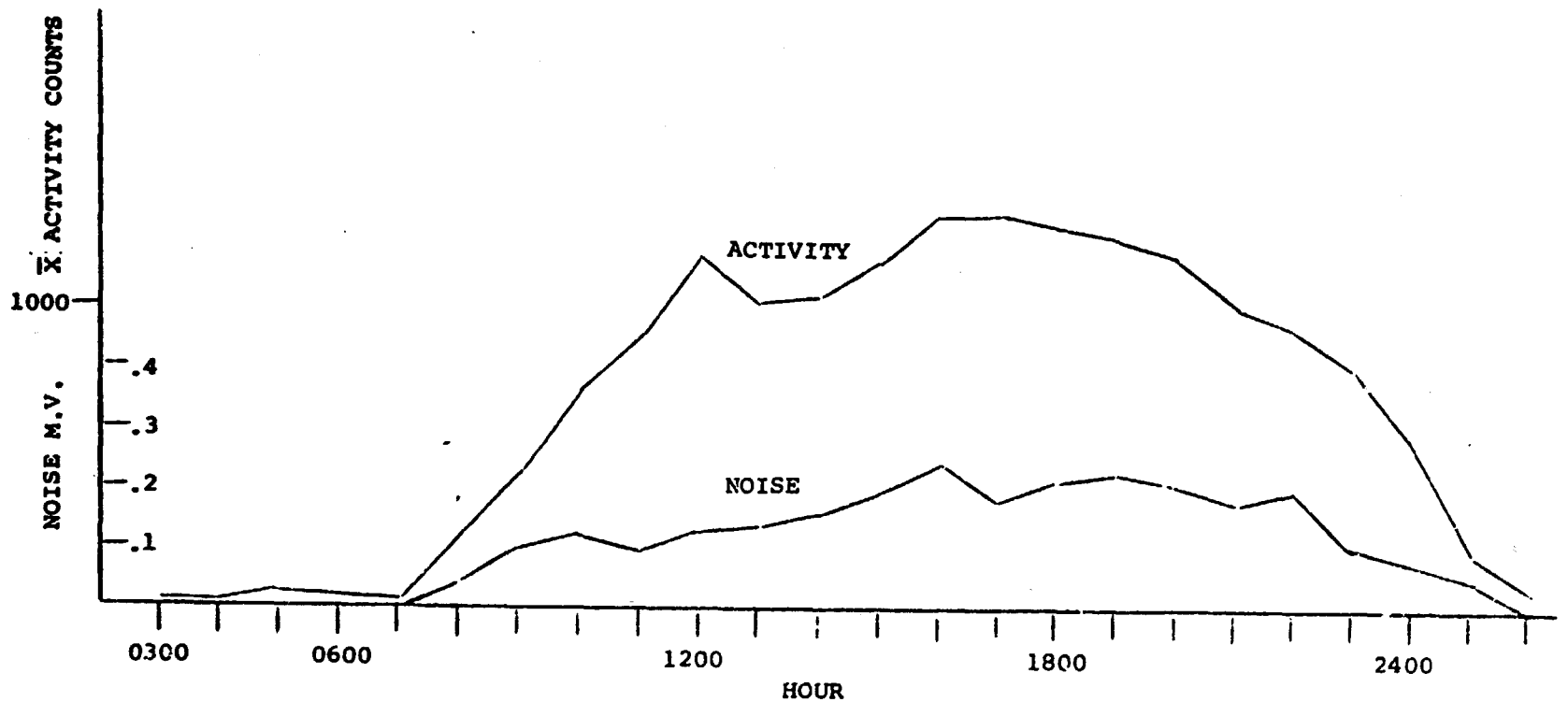

Figure 2. The Mean Hourly Activity and Noise Levels Averaged over the Eight Day Confinement Period (ES IV)

relied entirely upon the light reflected from the 7.5 w. lamp lighting the large observation window. The latrine 10 w. lamp (measured .6 foot-candles at floor level) supplied apparently adequate illumination for that area.

Changes in daily patterns of lighting reflected the activities of the group and followed closely changes in activity and noise level. Inspection of the daily lighting patterns revealed no unusual shifts as a function of confinement.